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MONTHLY INTELLIGENCE

RELATING TO

THE USEFUL ARTS,

PROCEEDINGS OF LEARNED SOCIETIES,

AND

NOTICES OF ALL PATENTS GRANTED FOR INVENTIONS.

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THE

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AGRICULTURE.

No. XXXVII. SECOND SERIES. June 1805.

Specification of the Patent granted to William Bell, *of the Town of Derby, Engineer; for an improved Method of manufacturing Blanks or Moulds for Knife, Razor, and Scissar Blades, and various other edge Tools, and of Forks, Files, and Nails.* Dated March 9, 1805.

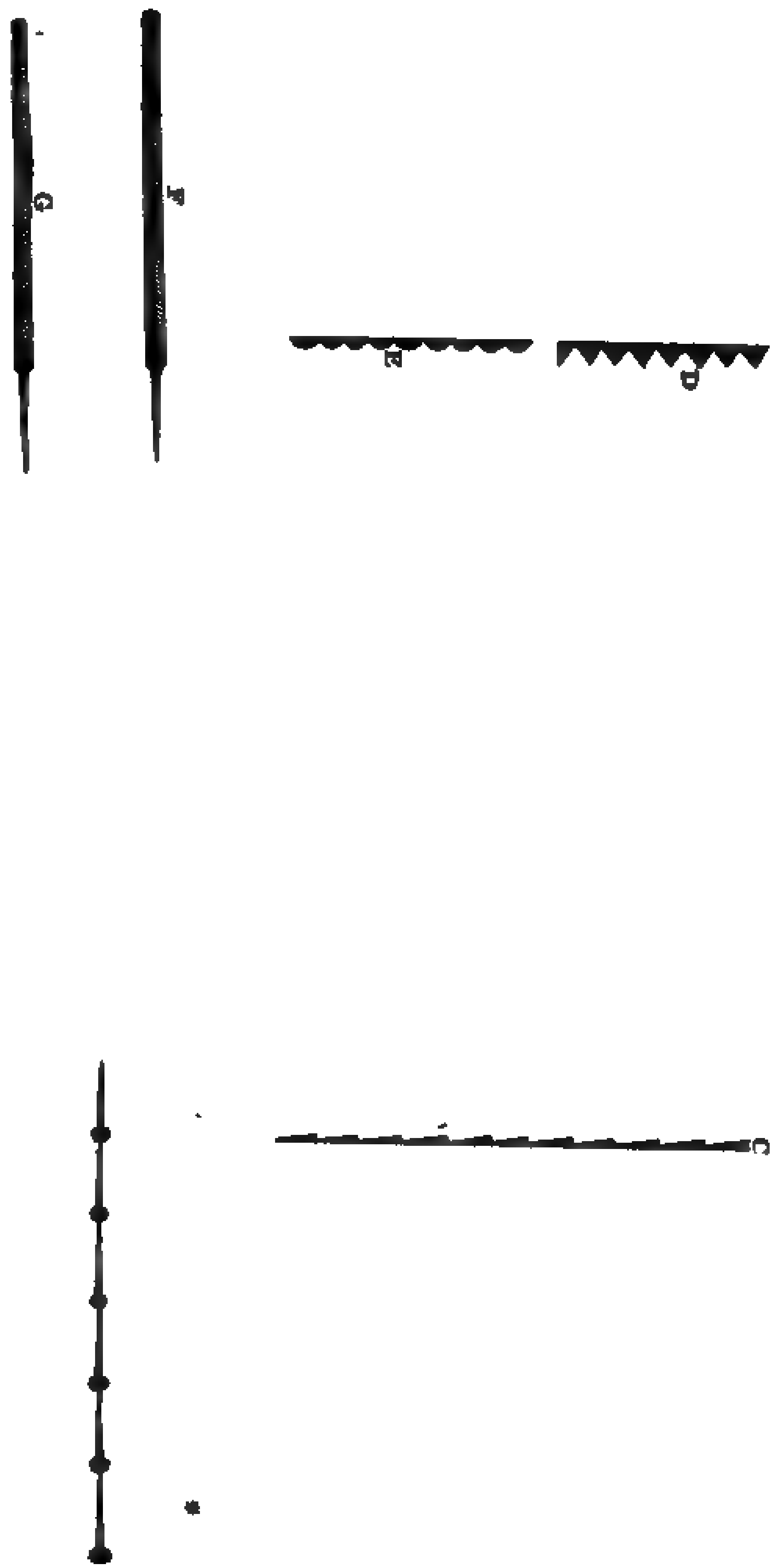
With a Plate.

TO all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, I the said William Bell do hereby particularly describe the nature of my said invention, and how the same is performed, as follows: I make use of frames and rollers which are actuated or worked by any of the mechanical powers similar to those which are commonly made use of for rolling or flatting iron, steel, silver, copper, and other malleable metals or substances; but the novelty of my application thereof is, that I cast, turn, or otherwise indent or form, on the surface of the said roller or rollers impressions, as described in the above drawings, (see Plate I.) First, as at A A, is the manner or shape to which my rollers are turned, cut, cast, or otherwise indented;

which rollers are made of cast iron, wrought iron, steel, or a mixture or combination of either of them. I place these impression-rollers together, or one of them that is not impressed against that which is, in the usual method of rollers applied as aforesaid; and by observing a nicety in fixing them parallel to each other, I pass between them, either in a hot or cold state, bars or sheets of steel, iron, silver, or any other metals, or their compounds, which have been previously rolled, or otherwise brought to a proper thickness or gauge, and which are sufficiently ductile to receive an impression by means of my said process, the effects of which will be seen by looking at B, or at the end-view, as represented at C. This shews the back and edge of a knife, razor, or scissar blade, as well as a variety of other edge tools, which may be made from metal thus formed, or the thick and thin part, which is also calculated to cut nails from, as hereafter described, from any substances proper to be applied to the making of nails. But my principal intention is to make thereby copper or iron nails, or sprigs or blanks for them, preparatory to heading. And by the same means I produce my blanks or moulds for making files and forks, but with this difference; I cut, cast, turn, or otherwise indent, on the surface of my roller or rollers, suitable impressions for any size or form of files and forks which I want; some plans of which are shewn in the drawings of several shapes and forms of which files are generally made, as at D E F G. Thus having produced the necessary forms and figures of the various articles herein specified, I separate them from each other by means of a press or fly, or with shears, made of any form suitable to my purpose.

In witness whereof, &c.

Specification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Specification of the Patent granted to JOSEPH HUDDART, *of Highbury Terrace, in the Parish of Islington, in the County of Middlesex, Esquire; for a Method or Art of manufacturing and spinning Yarn, different from any now in use.* Dated September 21, 1804.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Joseph Huddart do hereby describe and ascertain the nature of my said invention, and the manner in which the same is to be performed, as follows; that is to say: This invention consists in a new mode of manufacturing and spinning yarn from hemp, flax, and other fibrous articles as hereinafter described; the advantage whereof is, that the fibres are laid in the yarn without being doubled, and as nearly as possible at their full length, and at the same time, without any superfluous consumption of the raw material in the composition of the yarn, wherein this mode differs from any such now in use.

To accomplish this, the fibres composing the yarn are laid at various lengths, according to the ratio of their relative positions in the yarn, or their respective distances from the centre thereof. This is performed by a moveable machine, which by its progression gives motion at the same time to spindles or spinning hooks contained in it, thereby also giving twist to the yarns to be spun.

The spinner, instead of walking backwards in spinning with the hemp, flax, or other article round him, remains stationary, whilst the hemp, &c. is laid at its whole length on a board, table, or other convenient support; in which is inserted a number of upright pins (as in a tool or hatchel), so as to receive and support about half the

length of the hemp, flax, or other article, or from the thickest part of the head of hemp, flax, or other article, to the end of the fibres farthest from the machine. The other part or end of the article to be spun is held by the spinner, and directed towards the machine, which is brought to a convenient distance, and the spinner begins the operation by drawing some fibres of the hemp, flax, or other article, and making them fast to one of the spindles or spinning hooks. The spinner has a cloth in one hand to hold and compress the yarn, and with the other hand he feeds the yarn from the hemp, flax, or other article. At this period motion is given to the machine in manner hereinafter mentioned.

By this method the longest hemp, flax, or other article may be spun without having its fibres reduced in length; for the pins above mentioned occasion all the fibres to be drawn to their full respective length, or nearly so, (excepting the unavoidable shortening by twisting), and the said pins also prevent irregular drawings of the fibres.

This invention is well adapted to spinning, from slivers or rovings previously prepared by such machinery as hath been used, or may be used, for hemp or flax. These slivers or rovings are to be delivered by rollers, in any required ratio or proportion to the length of yarns, and compressed by some flexible substance, such as cloth, list, or leather, and which compression may be given by a weight attached to the flexible substance or otherwise.

The construction of machines for drawing and twisting may be in various forms, as is well known to mechanics and spinners, who will easily understand the following description of that which I have used; which, by the arrangement of its several parts, and their mutual connection with each other, is commodiously adapted to the

the aforesaid operations of drawing and spinning. The said machine is in a wooden frame, placed upon trucks, wheels, or rollers, and it has motion communicated to it by a band of any required length, acted upon by man, horse, or by a mill or steam-engine, or by any other adequate power. This band is applied to a rigger, pulley, or whirl, on the axis of a cylinder in the machine; round which cylinder are bands of list, cloth, or some other flexible substance, and which bands give motion to the spindles or spinning hooks in any required number for twisting the yarn.

The spindles are placed either above or below the cylinder, at right angles thereto, or parallel to the motion of the machine. The motion of the cylinders also gives motion to the machine on its trucks, wheels, or rollers, by other wheels, or by a rigger connected by a band, in order to give a progressive motion to the machine, thereby drawing the hemp, flax, or other article (which is fed by the spinner or by the roving) to any required length. This progressive motion may be in any convenient direction, and it may be varied in any ratio or proportion to the motion of the spindles by changing the wheels, or by different-sized grooves in the riggers, or the hefts of the spindles may be varied in thickness, according to the intended size of yarn to be spun, so as to produce a proper twist.

When the machine has spun to the intended length, it is thrown out of gear by a clutch, or otherwise, and thereby the cylinder is disconnected from the band, which puts the machine in motion under the action of the power employed.

In witness whereof, &c.

Specification

Specification of the Patent granted to JOHN LEWIS, *of Lamb's-buildings, in the Parish of St. Luke, Old-street, in the County of Middlesex, Looking-Glass-manufacturer; for a Method for preventing Accidents by a Horse or Horses, or other Animals, drawing a Carriage or Carriages.* Dated February 27, 1802.

With a Plate.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said last-mentioned proviso, I the said John Lewis do hereby declare, that my invention consists, first, as to extricating single horse-chaises, chairs, or other carriages, with two, three, or four wheels, and usually drawn with one horse, or any other animal.

That part of the harness from the saddle on the back of the horse to bear up the shafts I call the tugs: these are to have rings of brass or other metal, within the loops, sufficient to receive and be fastened by the bolt A, Fig I, Plate II, (see the explanation of the works hereunder written). The belly-band is likewise to have a loop at each end with rings of brass or other metal within them, and they are to be fastened by the same bolt as the tug. The kicking-strap (if one is used) may be buckled to the traces or fastened by like rings of brass or other metal with similar bolts of a smaller size. To the bolt A, near the end of the shafts, (and which is screwed on, or affixed thereto, in the manner in the explanation described,) a chain or conductor is fastened, and led on or under the shafts, and conducted by pullies to the wheel C, and thence to the wheel F, in the quadrant E, Fig. 14, where the commanding chain is fixed. Pieces of iron or other metal, four or five inches long, bent

bent in three squares, with rollers of brass or other metal fixed therein, and made to fit the shafts, and fastened to the tugs and belly-band, and a plate of iron, or other metal, fastened to the shafts for the rollers to run on, and a pin or catch underneath each shaft, to prevent the tug going on too far, may be used as to this part of the works instead of the bolts and chains, if preferred. The traces are fastened to the end of the bolt (Fig. 2) in the splintree, and from these bolts, chains, or conductors, are led round pullies in the splintree to a swivel, where the chains or conductors meet and are affixed; and thence are led by a chain or conductor from the centre of the swivel to the small wheel G, in the box E; or the traces may be fastened to the splintree by the bolts A, affixed at each end, and led by chains or conductors along the splintree by pullies into the box E. The splintrees to be fixed with a swivel, or any way to prevent them hanging too low. To all two-wheel carriages I fix a leg before and behind, N, Fig. 12. These legs are affixed to the rails with a hinge or hinges, and if the rails are not strong enough they may be strengthened by putting a piece of iron underneath them, or they may be fixed to small iron rails: to this iron rail two ears will be fixed for a pin to go through to form a hinge, Fig. 12. At the bottom of these legs is a wheel, O, seven or eight inches diameter, to prevent the carriage from stopping too suddenly. A screw, R, is fastened to the back of these legs near the centre, Fig. 12; and the ratchet Q works upon this screw R, and goes through the eye S, which is fixed to the axletree or elsewhere to keep it steady. When the legs are let down the wheels at the bottom of each will then hang about three inches from the ground, if the carriage is level.

level. Near the bottom of each of these legs there is also to be fixed a small piece of iron, or any other strong metal, P, sufficient to bear the legs when put up, with a hole at the end P, Fig. 12; these, when the legs are put up, fasten to the tumblers V, Fig. 13. The catch T, Fig. 13, being fastened to the carriage, (or elsewhere), from the levers, where the tumblers V, are fixed by a hinge, a chain, or conductor, leads round the pulley in the upright *a*, *a*, Fig. 13, and thence the chain or conductor W leads to the wheel F, in the box E. This box E, which contains the wheel F, G, L, I call the quadrant. This quadrant Fig 14, is fixed underneath the carriage, (or elsewhere,) where all the chains meet. The leading chain from the pulley K, is fastened to the handle M, to be fixed where most convenient, and by pulling this handle the bolts are drawn back, the horse or animal instantly set at liberty, and the legs N immediately drop to support the carriage from falling. A spring may be fixed at the top of these legs if required, which, pressing against the carriage, will force the legs down the sooner, remembering that all the chains must be so fixed as for them all to pull equal together. I have described this mode of fixing legs to guard against accidents by the carriage falling backwards or forwards, as from the present mode of building them the weight lays much behind, but one or two legs may be used at the pleasure of the owner of the carriage.

As to all carriages. To prevent accidents which may happen on going down hill by the carriages pressing on the horses, and on going up hill to prevent carriages from running back, as well as to guard against the pressure upon the machinery, ratchet wheels X, are to be fixed to the box or nave of the wheels,

by

by which they may be locked or unlooked at pleasure, without the necessity of alighting.

Fig. 15, the chain or conductor from the lever, which locks and unlocks them, is led into the carriage, or to the driver, as is also the other chain or conductor which fastens the mandle when the wheels are unlocked; but if they cannot go immediately to the desired place, they must be conducted round small wheels where they may be fixed, and the wheels may be locked or unlocked by pulling them.

Secondly, as to liberating horses or other animals from carriages commonly called curricles. As to the pole, Fig. 9, the chain or harness from the collar to the end of the pole is so constructed as to slip off or out upon the horses being disengaged from the carriage, and pushing forward by a spring, No. 7, fastened to the end at the side of the pole in a loop, and the loop in the chain or harness must be big enough to slip out or off the spring. As carriages of this description are suspended by the pole when in motion, the bolt A, already described or mentioned, is to be fixed to the pole near the centre Fig. 9; which bolt must be made stronger, to fasten the harness or round robbin, (which must have a loop or ring of brass or other metal within it) and the chain or conductor affixed to such bolt must be led along the pole, Fig. 9, immediately to either the wheel F or G, in the box E, and be fastened thereto. If the chain or conductor is fixed to the wheel G, the round robbin must be made narrower. The traces are to be fastened to the splintrees with the same kind of bolts as before described with respect to single horse chaises, &c. and the chains or conductors are to be led in the same manner as before observed to the swivel, and from thence round the

 pulley

pulley on wheel C, at the end of the bar, to the other pulley or wheel C, near the centre, where the two chains or conductors meet in one, Fig. 9. The wheels of this carriage may be also locked or unlocked, and the legs, &c. be applied to it in the same manner as before is mentioned with respect to the single horse chaise.

Thirdly, as to all four or more wheeled carriages having two or more horses: the horses are fastened from the collar to the end of the pole by the spring No. 7, as before-mentioned, to the pole of the curricle, and the traces, as at Fig. 10, are fastened to the rail by the bolt No. 4, and the chain or conductor from the bolt at the end of the rail is brought along the rail round the pulley or wheel C, near the centre, and fastened to the chain or conductor of the bolt near the pole to join with the chain or conductor from the bolt on the other side, and conducted to the wheel G in the quadrant; or the harness may be fastened by one bolt near the pole, Fig. 17.

When four horses are put to any carriage, the hook No. 6 must be fixed at the end of the pole No. 5 by a hinge to fall down when unbolted, to which the rail-bar or splintree is to hang by a loop. The loop must be long enough for the hook to fall through, which hook is to be bolted by the bolt A. The end of the bolt to be hollow, so as to receive the end of the hook, Fig. 10. A chain or conductor is conveyed along the pole to the wheel G, in the quadrant, and the commanding chain led to the driver. The bolts to these carriages must be made of sufficient strength for their situations, and their chains or conductors from them led any way by pulleys or wheels most convenient. To every carriage with three, four, or more wheels, the

the quadrant must be fixed so as to move round with the pole or front wheels in the centre over the pin that fastens the front wheel or wheels, to prevent the horses being disengaged by the motion of the pole; and the commanding chain must be longer, to give liberty for the quadrant to move and be conducted round a pulley or pulleys to the driver. The hind wheels of this carriage may be also locked or unlocked at pleasure, and the chains or conductors from the levers must be brought round pulleys to the driver or elsewhere; and by pulling them the wheel or wheels will be locked or unlocked at pleasure. The application of this plan must have the co-operation of the driver by his immediately throwing away the reins. All bolts, wheels, and the other apparatus, are to be oiled or greased with animal fat; and the machinery made of any metal of sufficient strength, according to their respective situations. All the works and machinery as can will be covered. The chains or conductors will be covered with leather, and the joints of the bolt No. 4, must likewise be covered with leather to keep them from the dust.

Explanation of the Works before referred to.

Note. For the References to the Figures, Letters, and other Particulars, see the Plan hereunto annexed, (Plate II.)

The bolt A, is made thus: I take a square piece of steel, brass, or any other metal of sufficient strength, the end of which is to be made round; a shoulder must be on the bolt, just far enough to give liberty for it to draw in and prevent it drawing through the staple. The square piece of steel, brass, or other metal under the bolt I call the inclining plane, near the end of which is a shoulder or catch. This lifts up the tumbler or pall, which is fixed to the bolt by a screw; close to the se-

cond staple it falls in a socket, and is kept fast by a spring. At the end of the inclining plane is a catch, which being pulled, the shoulder on the side lifts up the tumbler, and the catch at the end clinches in a notch under the bolt, and draws the bolt back. A nob is on the other side of the inclining plane to draw it forward, and a pin is in the plate near the last staple, which is fastened to the plate to keep it steady. This bolt slides through the staples, which are fastened to the plate, and which go through the shafts and fasten to an iron plate underneath with nuts and other screws. The staple *b*, *b*, at the front of the bolt, is made to move for the harness to slip on the bolt, which staple sinks into the plate and goes through the shafts, and fastens by a thumb-sorew underneath; or it may be made fast to the plate, in which case the bolt must be shot back to receive the loop or the ring of the harness; and the plate may also be fastened by straps of iron on the shafts, or otherwise, as most convenient. This bolt must run on rollers within side the staples when applied to the pole of a curricle, and these bolts may be used with rollers when affixed to the shaft or otherwise, to make them pull the easier. The box E, Fig. 14, which contains the wheels where the commanding chain is fixed, I call the quadrant, and it is made thus: I fasten the quadrant L, at the bottom of the box, to the large wheel F, to give purchase. This quadrant L must be made to the size and according to the purchase wanted; and the large wheel F, of a proper size to draw back the bolts on the shafts.

The small wheel G, to draw back the bolts in or on the splintree (Fig. 2.) is fastened to the large wheel F. The cross bar H, is to keep the works together, and a spindle is to go through the whole. I, I, are plates

plates of brass, or any other metal, to keep the chains or conductors up to their places. A pulley K is fixed in the box near the end of the quadrant, and a chain, which I call the commanding chain, fastens to the other end of the quadrant, and is brought round the pulley K, and when pulled, it will instantly disengage the horse or horses. The wheel and quadrant to be made of brass, or any other metal of sufficient strength, and kept from going too far round by a pin on each side. The splintree, Fig. 2, is made thus: a tube of brass or other metal is made of a proper size to receive a bolt and spring twisted round it, and is let into and fixed inside of the splintree. The chain or conductor is fastened to the bolt, and from the bolt brought round a pulley likewise fixed in the splintree, and conducted to a swivel, and thence led to the quadrant. The legs N, Fig. 12, are made of ash, or any strong wood, (the thickness according to the strength of the wood) with a piece of iron down the front, and fastened on with screws. A cap of iron, or other metal is to go over each end of the legs to keep them from splitting, and for the wheel at the bottom and the pin at the top to work; or legs of iron or other metal may be used. The screw R belonging to the legs is made with steel, or other metal, and a worm or screw runs near two thirds down it. The plane end has two iron ears fixed just wide enough to receive one side of the leg, and to project far enough over the other side to give liberty for a pin to go through and screw it to the leg. The two ears on the other end are to work on the screw close to the leg, and be fastened in the same manner. The ratchet Q, Fig. 16, is also of iron, or other metal, about three quarters of an inch wide and three eighths of an inch thick, more or

less,

less, according to the strength wanted; and is made long enough to catch at the end upon the axletree when the legs are down; but if it cannot run on the axletree, a piece of iron or other metal must be fixed for it to run on. At the end of the ratchet Q, I make a hole, with a worm to work on the screw R; at the other end of this ratchet are large teeth like a saw, and beat round at the end to prevent it from coming out of its place. The teeth are to catch against the axletree, or the piece of iron, or other metal, for that purpose. This is to prevent the legs from moving too far back. The catch T, Fig. 13, is made thus: I take a piece of iron, or other metal, about one inch wide, and of such other dimensions as will be strong enough to support the legs when put up. From the centre of this piece of iron, or other metal, I fix an upright piece, with a pulley near the top, for a chain or conductor to go through to the box or quadrant E: the length of each of these pieces of iron, or other metal, must be according to the place where they are to be fixed. The bottom plate must have a hole at each end to let the piece of iron or other metal P from the leg, go through to catch on a tumbler V. A small piece of iron, or other metal, which I call a lever, from the hole to the upright piece on the bottom plate fastens by a hinge on or near the upright with a spring to force it down. At the other end of this lever I fix a small piece of iron, or other metal, which I call a tumbler, to move up and down on a hinge, so that when the legs are put up they may catch or fasten themselves; and when pulled up by the lever, will let the legs instantly fall. This tumbler is prevented from moving too high or too low by a catch. The two ratchet wheels *x* are made thus: the wheels are of iron, or other metal,

and

Fig. 1.

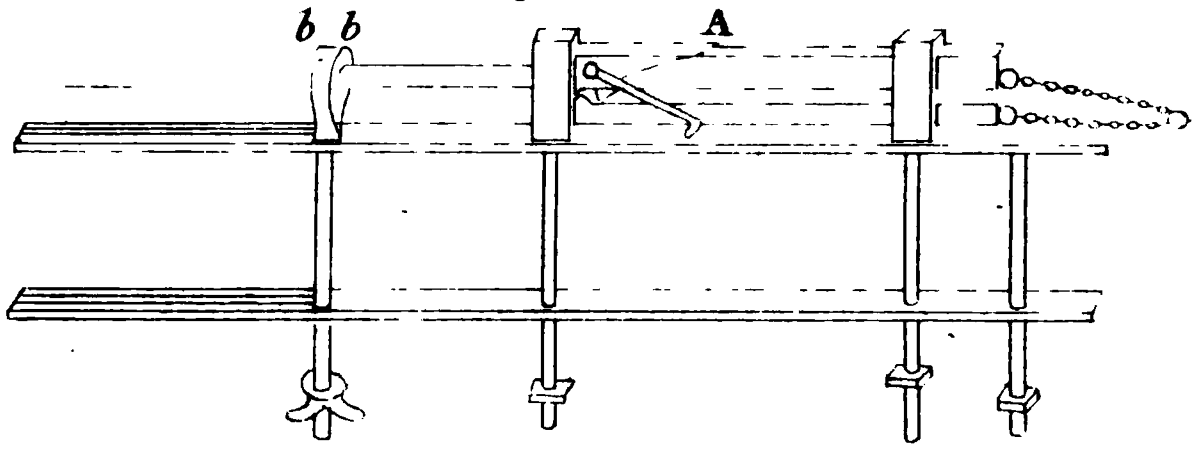
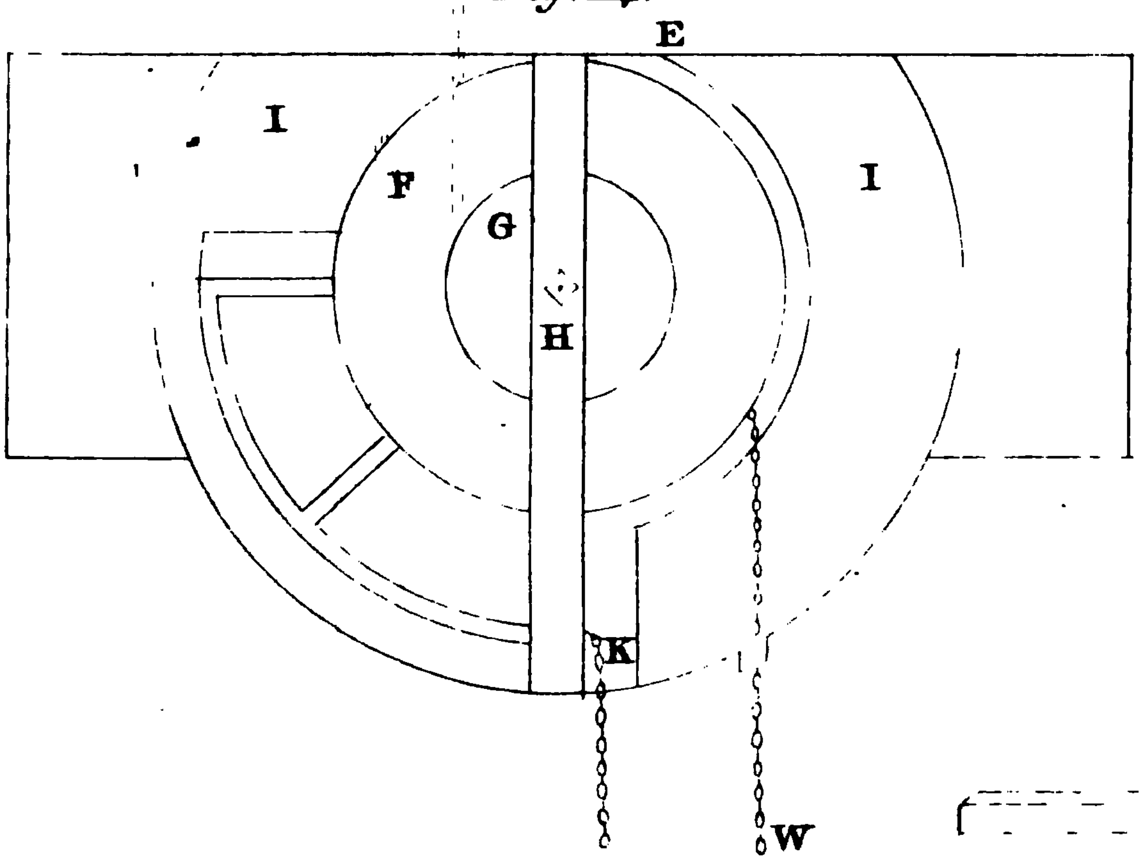


Fig. 14.



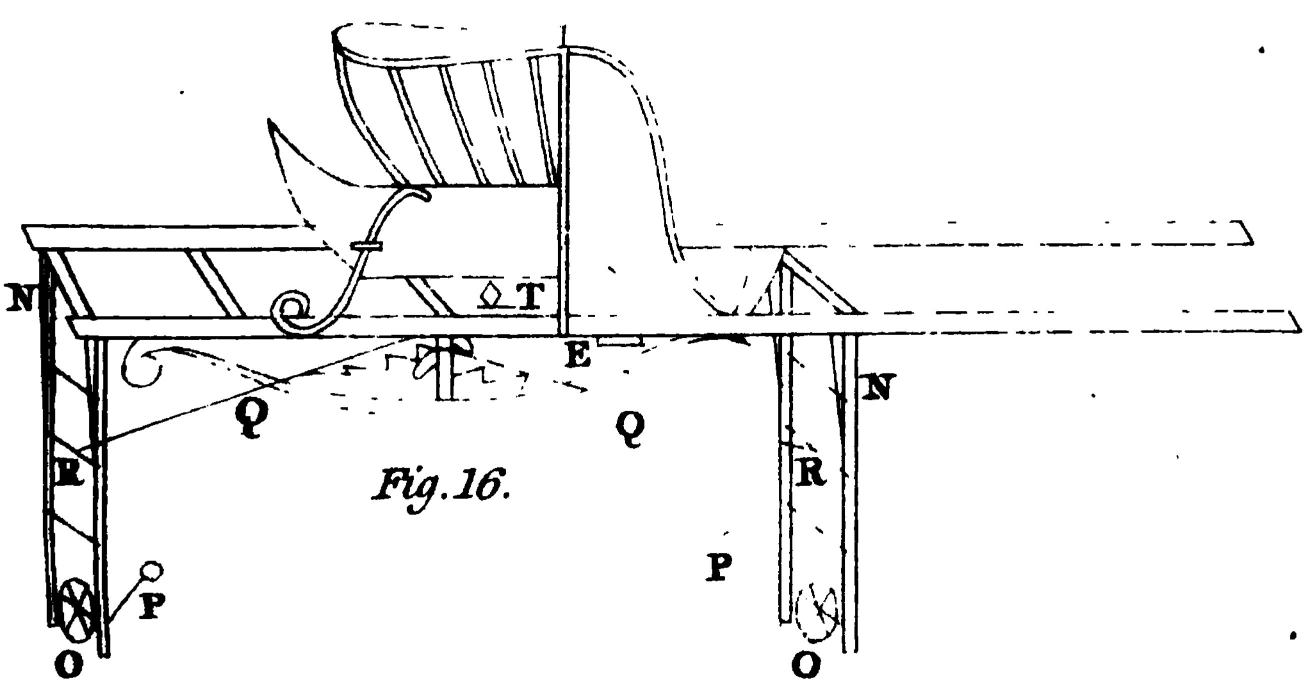


Fig. 16.

Nº 4.

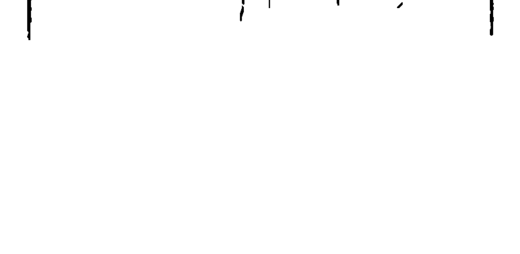


Fig. 17.

and fasten on the box or nave of the carriage wheels with large teeth like a saw, and fixed on contrary ways at a little distance from each other, as Fig. 15. I fix an upright piece of iron, or other metal, No. 1, to the axletree, with a hole at the top, which I call a collar; and a round piece of iron, or other metal, to come through, which I call the spindle or mandel Z. On the front of this spindle I fasten two pieces of iron, or other metal, which I call palls or clinks Y, to move up and down, and bent to catch on the ratchet. The other end of the spindle works in a socket fixed to the axletree or upright piece, No. 2, Fig. 15. At the end of this spindle I fix a catch to prevent it moving by the motion of the carriage, made thus: I take a piece of iron, or other metal, two inches long, more or less, and make a hole in the centre to put a pin through in the upright piece to let the catch move up and down, and to fall in a notch with a spring underneath the opposite end to keep it fast, and by pulling the lever it presses down the end of the catch, which lifts it out of the notch, and gives it liberty to move. To the same end I fix a piece of iron, or other metal, like a handle, which I call the lever, to fasten the chain and conductor to, and to move it up or down at the will of the driver, Fig. 15. The bolt, No. 4: I take a piece of iron, or other metal of sufficient thickness to sink a socket or hole at one end; near this hole I fix two uprights, with a piece of strong iron, or other metal, across, with a hole the same size as that at the bottom for the bolt to drop through the top into the bottom. This bolt is to have a hinge near the top, so that when drawn out of the bottom hole to bend; and the joint must be placed, not to go through the top hole when drawn up, but to

give

give liberty to bend; and the loops in the traces must be long enough to clear the bolts. At a little distance from the upright, I fix another a little higher or longer. To this last-mentioned upright I fasten a lever, with a hinge to fasten the bolt in like manner, and a spring underneath this lever to keep the bolt in its place. See plan No. 4. This and all the apparatus to be made as strong as may be required.

In witness whereof, &c.

Specification of the Patent granted to JOSHUA JOWETT, *of High Holborn, in the County of Middlesex, Ironmonger; for a Fire-Guard Stove, whereby Accidents from Fire in Houses and other Places that have heretofore been occasioned by Grates and Stoves, made on any other Construction, are effectually prevented, and which will render the usual Fire-Guards for Children and other Purposes unnecessary.* Dated May 18, 1804.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Joshua Jowett do hereby declare, that the following is a particular description of the nature of my invention, and of the manner in which the same is to be performed; that is to say: The fire-guard may be attached or fixed to any stove which will admit of two centres or pivots being placed perpendicularly in front of the back, or at the back of the back of the stove, with a lever-crank to each, projecting from the fire-guard, to guide the guard's action, the stove admitting of a groove on either side for the guard to pass through, as the levers shall direct; and when such fire-guard is so fixed or fastened to any such stove it then becomes a fire-guard

stove.

stove. The fire-guard may be made either of a solid plate or open-work, of brass, iron, copper, plated or silver wire, or cast or stamped, or wrought open-work, of any metal or compound of metals.

The principle of the action of the fire-guard in conjunction with the stove is, its being united to two centres or pivots, placed perpendicular one to the other, and is connected to the two centres fixed to the stove by means of two lever cranks, one end of which being fixed to the guard, and the other end of each to the centres or pivots; by which the guard swings in a rotary motion, passing through a groove formed in the stove, on either side, to swing before the fire when required, and being brought into use by means of a handle or nob, fastened to the front edge of the frame of the guard for that purpose; or, instead of drawing it out with the hand, as before described, it may be brought into use by means of a spring being fastened to the crank, and pressing against the cheek or back of the stove, to throw the guard forward; or by means of a balance, fastened to any part of such fire-guard, and working with a line or chain through pullies fixed to the stove; or by means of the combined force of the spring and balance.

The fire-guard may, if thought necessary, be divided into two parts, yet acting upon the same principle, and in the same manner, as is herein before described, except only, that when the guard is divided the stove may, if necessary, have a groove on each side for the guards to pass through, instead of a groove on one side, as is herein before mentioned; in which case the double guard will meet or close in the centre of the front of the fire.

In witness whereof, &c.

Essay on the Cohesion of Fluids.

By THOMAS YOUNG, M. D. For. Sec. R. S.

From the PHILOSOPHICAL TRANSACTIONS of the ROYAL SOCIETY.

I. *General Principles.*

IT has already been asserted, by Mr. Monge and others, that the phenomena of capillary tubes are referable to the cohesive attraction of the superficial particles only of the fluids employed, and that the surfaces must consequently be formed into curves of the nature of lintearix, which are supposed to be the results of a uniform tension of the surface, resisting the pressure of a fluid, either uniform, or varying according to a given law. Segner, who appears to have been the first that maintained a similar opinion, has shewn in what manner the principle may be deduced from the doctrine of attraction, but his demonstration is complicated, and not perfectly satisfactory; and in applying the law to the forms of drops, he has neglected to consider the very material effects of the double curvature, which is evidently the cause of the want of a perfect coincidence of some of his experiments with his theory. Since the time of Segner, little has been done in investigating accurately and in detail the various consequences of the principle.

It will perhaps be most agreeable to the experimental philosopher, although less consistent with the strict course of logical argument, to proceed in the first place to the comparison of this theory with the phenomena, and to inquire afterwards for its foundation in the ultimate properties of matter. But it is necessary

necessary to premise one observation, which appears to be new, and which is equally consistent with theory and with experiment; that is, that for each combination of a solid and a fluid, there is an appropriate angle of contact between the surfaces of the fluid, exposed to the air, and to the solid. This angle, for glass and water, and in all cases where a solid is perfectly wetted by a fluid, is evanescent; for glass and mercury, it is about 140°, in common temperatures, and when the mercury is moderately clean.

II. *Form of the Surface of a Fluid.*

It is well known, and it results immediately from the composition of forces, that where a line is equally distended, the force that it exerts, in a direction perpendicular to its own, is directly as its curvature; and the same is true of a surface of simple curvature; but where the curvature is double, each curvature has its appropriate effect, and the joint force must be as the sum of the curvatures in any two perpendicular directions. For this sum is equal, whatever pair of perpendicular directions may be employed, as is easily shown by calculating the versed sines of two equal arcs taken at right angles in the surface. Now when the surface of a fluid is convex externally, its tension is produced by the pressure of the particles of the fluid within it, arising from their own weight, or from that of the surrounding fluid; but when the surface is concave, the tension is employed in counteracting the pressure of the atmosphere, or, where the atmosphere is excluded, the equivalent pressure arising from the weight of the particles suspended from it by means of their cohesion, in the same manner as, when water is supported by the atmospheric pressure in an inverted

vessel, the outside of the vessel sustains a hydrostatic pressure proportionate to the height; and this pressure must remain unaltered, when the water, having been sufficiently boiled, is made to retain its situation for a certain time by its cohesion only, in an exhausted receiver. When, therefore, the surface of the fluid is terminated by two right lines, and has only a simple curvature, the curvature must be every where as the ordinate; and where it has a double curvature, the sum of the curvatures in the different directions must be as the ordinate. In the first case, the curve may be constructed by approximation, if we divide the height at which it is either horizontal or vertical into a number of small portions, and taking the radius of each portion proportional to the reciprocal of the height of its middle point above or below the general surface of the fluid, go on to add portions of circles joining each other, until they have completed as much of the curve as is required. In the second case, it is only necessary to consider the curve derived from a circular basis, which is a solid of revolution; and the centre of that circle of curvature, which is perpendicular to the section formed by a plane passing through the axis, is in the axis itself, consequently in the point where the normal of the curve intersects the axis; we must therefore here make the sum of this curvature, and that of the generating curve, always proportional to the ordinate. This may be done mechanically by beginning at the vertex, where the two curvatures are equal, then, for each succeeding portion, finding the radius of curvature by deducting the proper reciprocal of the normal, at the beginning of the portion, from the ordinate, and taking the reciprocal of the remainder. In this case the analysis leads to fluxional equations of the

the second order, which appear to afford no solution by means hitherto discovered; but the cases of simple curvature may be more easily subjected to calculation.

III. *Analysis of the simplest Forms.*

Supposing the curve to be described with an equable angular velocity, its fluxion, being directly as the radius of curvature, will be inversely as the ordinate, and the rectangle contained by the ordinate and the fluxion of the curve will be a constant quantity; but this rectangle is to the fluxion of the area, as the radius to the cosine of the angle formed by the curve with the horizon; and the fluxion of the area varying as the cosine, *the area* itself will vary as the sine of this angle, and *will be equal to the rectangle contained by the initial ordinate, and the sine corresponding to each point of the curve in the initial circle of curvature.* Hence it follows, first, that *the whole area, included by the ordinates where the curve is vertical and where it is horizontal, is equal to the rectangle contained by the ordinate and the radius of curvature;* and, secondly, that the area on the convex side of the curve, between the vertical tangent and the least ordinate, is equal to the whole area on the concave side of the curve between the same tangent and the greatest ordinate.

In order to find the ordinate corresponding to a given angular direction, we must consider that the fluxion of the ordinate at the vertical part is equal to the fluxion of the circle of curvature there, that, in other places, it varies as the radius of curvature and the sine of the angle formed with the horizon conjointly, or as the ordinate inversely, and directly as the sine of elevation; therefore the fluxion of the ordinate multiplied by the ordinate is equal to the fluxion of any circle

circle of curvature multiplied by its corresponding height, and by the sine, and divided by the radius: but the fluxion of the circle multiplied by the sine and divided by the radius, is equal to the fluxion of the versed sine; therefore the ordinate multiplied by its fluxion is equal to the initial height multiplied by the fluxion of the versed sine in the corresponding circle of curvature; and *the square of the ordinate is equal to the rectangle contained by the initial height and twice the versed sine, increased by a constant quantity.* Now at the highest point of the curve, the versed sine becomes equal to the diameter, and the square of the initial height to the rectangle contained by the initial height and twice the diameter, with the constant quantity: the constant quantity is therefore equal to the rectangle contained by the initial height and its difference from twice the diameter: *this constant quantity is the square of the least ordinate*, and *the ordinate is every where a mean proportional between the greatest height and the same height diminished by twice the versed sine of the angular depression in the corresponding circle of curvature.* Again, *at the vertical point, the square of the ordinate is equal to the square of the greatest height diminished by the rectangle contained by this height and the diameter of the corresponding circle of curvature*, a rectangle which is constant for every fluid, and which may be called *the appropriate rectangle: deducting this rectangle from the square of the ordinate at the vertical point, we have the least ordinate;* which consequently vanishes *when the square of the ordinate at the vertical point is equal to the appropriate rectangle; the horizontal surface becoming in this case an asymptote to the curve, and the square of the greatest ordinate being equal to twice the appropriate rectangle, and the greatest ordinate to twice the diameter of the corresponding circle of curvature:*

so

so that, *if we suppose a circle to be described, having this ordinate for a diameter, the chord of the angular elevation in this circle will be always equal to the ordinate at each point*, and *the ordinate will vary as the sine of half the angle of elevation, whenever the curve has an asymptote.* Mr. Fuss has demonstrated, in the third volume of the *Acta Petropolitana*, some properties of the arch of equilibrium under the pressure of a fluid, which is the same as one species of the curves here considered. The series given by Euler in the second part of the same volume, for the elastic curve, may also be applied to these curves.

IV. *Application to the Elevation of particular Fluids.*

The simplest phenomena, which afford us data for determining the fundamental properties of the superficial cohesion of fluids, are their elevation and depression between plates and in capillary tubes, and their adhesion to the surfaces of solids which are raised in a horizontal situation to a certain height above the general surface of the fluids. When the distance of a pair of plates, or the diameter of a tube, is very minute, the curvature may be considered as uniform, and the appropriate rectangle may readily be deduced from the elevation, recollecting that the curvature in a capillary tube is double, and the height therefore twice as great as between two plates. In the case of the elevation of a fluid in contact with a horizontal surface, the ordinate may be determined from the weight required to produce a separation; and the appropriate rectangle may be found in this manner also, the angle of contact being properly considered, in this as well as in the former case. It will appear that these experiments by no means exhibit an immediate measure of the mutual

attraction

attraction of the solid and fluid, as some authors have supposed.

Sir Isaac Newton asserts, in his Queries, that water ascends between two plates of glass at the distance of one hundredth of an inch, to the height of about one inch; the product of the distance and the height being about .10; but this appears to be much too little. In the best experiment of Musschenbroek, with a tube, half of the product was .0196; in several of Whitbrecht, apparently very accurate, .0214. In Monge's experiments on plates, the product was 2.6 or 2.7 lines, about .0210. Mr. Atwood says that for tubes, the product is .0530, half of which is .0265. Until more accurate experiments shall have been made, we may be contented to assume .02 for the rectangle appropriate to water, and .04 for the product of the height in a tube by its bore. Hence, when the curve becomes infinite, its greatest ordinate is .2, and the height of the vertical portion, or the height of ascent against a single vertical plane .14, or nearly one-seventh of an inch.

Now when a horizontal surface is raised from a vessel of water, the surface of the water is formed into a lintearia, to which the solid is a tangent at its highest point, and if the solid be still further raised, the water will separate: the surface of the water, being horizontal at the point of contact, cannot add to the weight tending to depress the solid, which is therefore simply the hydrostatic pressure of a column of water equal in height to the elevation, in this case one-fifth of an inch, and standing on the given surface. The weight of such a column will be $50\frac{1}{2}$ grains for each square inch; and in Taylor's well-known experiment the weight required was 50 grains. But when the solid employed is small, the curvature of the horizontal section of the water, which

which is convex externally, will tend to counteract the vertical curvature, and to diminish the height of separation; thus if a disc of an inch in diameter were employed, the curvature in this direction would perhaps be equivalent to the pressure of about one-hundredth of an inch, and might reduce the height from .2 to about .19, and the weight in the same proportion. There is however as great a diversity in the results of different experiments on the force required to elevate a solid from the surface of a fluid, as in those of the experiments in capillary tubes: and indeed the sources of error appear to be here more numerous. Mr. Achard found that a disc of glass, 1½ inch French in diameter, required at 69° of Fahrenheit, a weight of 91 French grains to raise it from the surface of water; this is only 37 English grains for each square inch; at 44½° the force was $\frac{1}{14}$ greater, or 39½ grains; the difference being $\frac{1}{343}$ for each degree of Fahrenheit. It might be inferred from these experiments, that the height of ascent in a tube of a given bore, which varies in the duplicate ratio of the height of adhesion, is diminished about $\frac{8}{180}$ for every degree of Fahrenheit that the temperature is raised above 50°; there was however probably some considerable source of error in Achard's experiments, for I find that this diminution does not exceed $\frac{1}{1000}$. The experiments of Mr. Dutour make the quantity of water raised equal to 44.1 grains for each square inch. Mr. Achard found the force of adhesion of sulphuric acid to glass, at 69° of Fahrenheit, 1.26, that of water being 1, hence the height was as .69 to 1, and its square as .47 to 1, which is the corresponding proportion for the ascent of the acid in a capillary tube, and which does not very materially differ from the proportion of .395 to 1, assigned by Barruel for this ascent.

 Musschenbroek

Musschenbroek found it .8 to 1, but his acid was probably weak. For alcohol the adhesion was as .593, the height as .715, and its square as .510: the observed proportion in a tube, according to an experiment of Musschenbroek, was about .550, according to Carré from .400 to .440. The experiments of sulphuric ether do not agree quite so well, but its quality is liable to very considerable variations. Dutour found the adhesion of alcohol that of water being 1.

With respect to mercury, it has been shown by Professor Casbois of Metz, and by others, that its depression in tubes of glass depends on the imperfection of the contact, and that when it had been boiled in the tube often enough to expel all foreign particles, the surface may even become concave instead of convex, and the depression be converted into an elevation. But in barometers, constructed according to the usual methods, the angle of the mercury will be found to differ little from 140°; and in other experiments, when proper precautions are taken, the inclination will be nearly the same. The determination of this angle is necessary for finding the appropriate rectangle for the curvature of the surface of mercury, together with the observations of the quantity of depression in tubes of a given diameter. The table published by Mr. Cavendish from the experiments of his father, Lord Charles Cavendish, appears to be best suited for this purpose. I have constructed a diagram, according to the principles already laid down, for each case, and I find that the rectangle which agrees best with the phenomena is .01. The mean depression is always .015, divided by the diameter of the tube: and in tubes less than half an inch in diameter, the curve is very nearly elliptic, and the central depression in the tube of a barometer may be

found

found by deducting from the corresponding mean depression the square root of one-thousandth part of its diameter. There is reason to suspect a slight inaccuracy towards the middle of Lord Cavendish's Table, from a comparison with the calculated mean depression, as well as from the results of the mechanical construction. The ellipsis approaching nearest to the curve may be determined by the solution of a biquadratic equation.

Diameter in inches.	Grains in an inch. C.	Mean depression by calculation Y.	Central depression by observation. C.	Central depression by formula. Y.	Central depression by diagram. Y.	Marginal depression by diagram. Y.
.6	972	.025	.005	(.001)	.005	.066
.5	675	.030	.007	.008	.007	.067
.4	432	.037	.015	.017	.012	.069
.35	331	.043	.025	.024	.017	.072
.30	243	.050	.036	.033	.027	.079
.25	169	.060	.050	.044	.038	.086
.20	108	.075	.067	.061	.056	.096
.15	61	.100	.092	.088	.085	.116
.10	27	.050	.140	.140	.140	.161

 The

The square root of the rectangle .01, or .1, is the ordinate where the curve would become vertical if it were continued; but in order to find the height at which it adheres to a vertical surface, we must diminish this ordinate in the proportion of the sine of 25° to the sine of 45°, and it will become .06, for the actual depression in this case. The elevation of the mercury that adheres to the lower horizontal surface of a piece of glass, and the thickness at which a quantity of mercury will stand when spread out on glass, supposing the angle of contact still 140°, are found, by taking the proportion of the sines of 20° and of 70° to the sine of 45°, and are therefore .0484 and .1330 respectively. If, instead of glass, we employed any surface capable of being wetted by mercury, the height of elevation would be .141, and this is the limit of the thickness of a wide surface of mercury supported by a substance wholly incapable of attracting it. Now the hydrostatic pressure of a column of mercury .0484 in thickness on a disc of one inch diameter would be 131 grains; to this the surrounding elevation of the fluid will add about 11 grains for each inch of the circumference, with some deduction for the effect of the contrary curvature of the horizontal section, tending to diminish the height; and the apparent cohesion thus exhibited will be about 160 grains, which is a little more than four times as great as the apparent cohesion of glass and water. With a disc 11 lines in diameter Mr. Dutour found it 194 French grains, which is equivalent to 152 English grains, instead of 160, for an inch, a result which is sufficient to confirm the principles of the calculation. The depth of a quantity of mercury standing on glass I have found by actual observation to agree precisely with this calculation. Segner says

says that the depth was .1358, both on glass and on paper: the difference is very trifling, but this measure is somewhat too great for glass, and too small for paper, since it appears, from Dutour's experiments, that the attraction of paper to mercury is extremely weak.

If a disc of a substance capable of being wetted by mercury, an inch in diameter, were raised from its surface in a position perfectly horizontal, the apparent cohesion should be 381 grains, taking .141 as the height: and for a French circular inch, 433 grains, or 528 French grains. Now, in the experiments of Morveau, the cohesion of a circular inch of gold to the surface of mercury appeared to be 446 grains, of silver 429, of tin 418, of lead 397, of bismuth 372, of zinc 204, of copper 142, of metallic antimony 126, of iron 115, of cobalt 8: and this order is the same with that in which the metals are most easily amalgamated with mercury. It is probable that such an amalgamation actually took place in some of the experiments, and affected their results, for the process of amalgamation may often be observed to begin almost at the instant of contact of silver with mercury; and the want of perfect horizontality appears in a slight degree to have affected them all. A deviation of one-fiftieth of an inch would be sufficient to have produced the difference between 446 grains and 528; and it is not impossible that all the differences, as far down as bismuth, may have been accidental. But if we suppose the gold only to have been perfectly wetted by the mercury, and all the other numbers to be in due proportions, we may find the appropriate angle for each substance by deducting from 180°, twice the angle of which the sine is to the radius as the apparent cohesion of each to 446 grains; that is, for gold .1, for silver about .97, for tin .95, for lead .90, for bis-

muth

muth .85, for zinc .46, for copper .32, for antimony .29, for iron .26, and for cobalt .02, neglecting the surrounding elevation, which has less effect in proportion as the surface employed is larger. Gellert found the depression of melted lead in a tube of glass multiplied by the bore equal to about .0054.

It would perhaps be possible to pursue these principles so far as to determine in many cases the circumstances under which a drop of any fluid would detach itself from a given surface. But it is sufficient to infer, from the law of the superficial cohesion of fluids, that the linear dimensions of similar drops depending from a horizontal surface must vary precisely in the same ratio as the heights of ascent of the respective fluids against a vertical surface, or as the square root of the heights of ascent in a given tube; hence the magnitudes of similar drops of different fluids must vary as the cubes of the square roots of the heights of ascent in a tube. I have measured the heights of ascent of water and of diluted spirit of wine in the same tube, and I found them nearly as 100 to 64: a drop of water falling from a large sphere of glass weighed 1.8 grains, a drop of the spirit of wine about .85, instead of .82, which is nearly the weight that would be inferred from the consideration of the heights of ascent, combined with that of the specific gravities. We may form a conjecture respecting the probable magnitude of a drop by inquiring what must be the circumference of the fluid, that would support by its cohesion the weight of a hemisphere depending from it: this must be the same as that of a tube, in which the fluid would rise to the height of one-third of its diameter; and the square of the diameter must be three times as great as the appropriate product; or, for water .12; whence the diameter would be

be .35, or a little more than one-third of an inch, and the weight of the hemisphere would be 2.8 grains, if more water were added internally, the cohesion would be overcome, and the drop would no longer be suspended, but it is not easy to calculate what precise quantity of water would be separated with it. The form of a bubble of air rising in water is determined by the cohesion of the internal surface of the water exactly in the same manner as the form of a drop of water in the air. The delay of a bubble of air at the bottom of a vessel appears to be occasioned by a deficiency of the pressure of the water between the air and the vessel; it is nearly analogous to the experiment of making a piece of wood remain immersed in water, when perfectly in contact with the bottom of the vessel containing it. This experiment succeeds however far more readily with mercury, since the capillary cohesion of the mercury prevents its insinuating itself under the wood.

TO BE CONCLUDED IN OUR NEXT.

Concerning the State in which the true Sap of Trees is deposited during Winter. In a Letter from THOMAS ANDREW KNIGHT, *Esquire, to the Right Hon. Sir* JOSEPH BANKS, *Bart. K. B. P. R. S.*

From the PHILOSOPHICAL TRANSACTIONS of the ROYAL SOCIETY.

IT is well known that the fluid, generally called the sap in trees, ascends in the spring and summer from their roots, and that in the autumn and winter it is not, in any considerable quantity, found in them; and I have observed

served in a former paper, that this fluid rises wholly through the alburnum, or sap-wood. But Du Hamel and subsequent naturalists have proved, that trees contain another kind of sap, which they have called the true, or peculiar juice, or sap of the plant. Whence this fluid originates does not appear to have been agreed by naturalists; but I have offered some facts to prove that it is generated by the leaf *; and that it differs from the common aqueous sap owing to changes it has undergone in its circulation through that organ: and I have contended that from this fluid (which Du Hamel has called the *suc propre*, and which I will call the true sap) the whole substance, which is annually added to the tree, is derived. I shall endeavour in the present paper to prove that this fluid, in an inspissated state, or some concrete matter deposited by it, exists during the winter in the alburnum, and that from this fluid or substance, dissolved in the ascending aqueous sap, is derived the matter which enters into the composition of the new leaves in the spring, and thus furnishes those organs which were not wanted during the winter, but which are essential to the further progress of vegetation.

Few persons at all conversant with timber are ignorant that the alburnum, or sap-wood of trees, which are felled in the autumn or winter, is much superior in quality to that of other trees of the same species, which are suffered to stand till the spring or summer: it is at once more firm and tenacious in its texture, and more durable. This superiority in winter-felled wood has been generally attributed to the absence of the sap at that season; but the appearance and qualities of the wood seem more justly to warrant the conclusion, that some substance has been

* See Phil. Trans. of 1801, page 336.

added

added to, instead of taken from it; and many circumstances induced me to suspect that this substance is generated, and deposited within it, in the preceding summer and autumn.

Du Hamel has remarked, and is evidently puzzled with the circumstance, that trees perspire more in the month of August, when the leaves are full grown, and when the annual shoots have ceased to elongate, than at any earlier period; and we cannot suppose the powers of vegetation to be thus actively employed, but in the execution of some very important operation. Bulbous and tuberous roots are almost wholly generated after the leaves and stems of the plants to which they belong have attained their full growth; and I have constantly found in my practice as a farmer, that the produce of my meadows has been immensely increased when the herbage of the preceding year had remained to perform its proper office till the end of the autumn, on ground which had been mowed early in the summer. Whence I have been led to imagine, that the leaves, both of trees and herbaceous plants, are alike employed, during the latter part of the summer, in the preparation of matter calculated to afford food to the expanding buds and blossoms of the succeeding spring, and to enter into the composition of new organs of assimilation.

If the preceding hypothesis be well founded, we may expect to find that some change will gradually take place in the qualities of the aqueous sap of trees during its ascent in the spring; and that any given portion of winter-felled wood will at the same time possess a greater degree of specific gravity, and yield a larger quantity of extractive matter, than the same quantity of wood which has been felled in the spring or in the early part of the summer. To ascertain these points I made the experiments,

an account of which I have now the honour to lay before you.

As early in the last spring as the sap had risen in the sycamore and birch, I made incisions into the trunks of those trees, some close to the ground, and others at the elevation of seven feet, and I readily obtained from each incision as much sap as I wanted. Ascertaining the specific gravity of the sap of each tree, obtained at the different elevations, I found that of the sap of the sycamore, with very little variation, in different trees, to be 1.004 when extracted close to the ground, and 1.008 at the height of seven feet. The sap of the birch was somewhat lighter; but the increase of its specific gravity, at greater elevation, was comparatively the same. When extracted near the ground the sap of both kinds was almost free from taste, but when obtained at a greater height, it was sensibly sweet. The shortness of the trunks of the sycamore trees, which were the subjects of my experiments, did not permit me to extract the sap at a greater elevation than seven feet, except in one instance, and in that, at twelve feet from the ground, I obtained a very sweet fluid, whose specific gravity was 1.012.

I conceived it probable, that if the sap in the preceding cases derived any considerable portion of its increased specific gravity from matter previously existing in the alburnum, I should find some diminution of its weight, when it had continued to flow some days from the same incision, because the alburnum in the vicinity of that incision would, under such circumstances, have become in some degree exhausted: and on comparing the specific gravity of the sap which had flowed from a recent and an old incision, I found that from the old to be reduced to 1.002, and that from the recent one

one to remain 1.004, as in the preceding cases, the incision being made close to the ground. Wherever extracted, whether close to the ground, or at some distance from it, the sap always appeared to contain a large portion of air.

In the experiments to discover the variation in the specific gravity of the alburnum of trees at different seasons, some obstacles to the attainment of any very accurate results presented themselves. The wood of different trees of the same species, and growing in the same soil, or that taken from different parts of the same tree, possesses different degrees of solidity; and the weight of every part of the alburnum appears to increase with its age, the external layers being the lightest. The solidity of wood varies also with the greater or less rapidity of its growth. These sources of error might apparently have been avoided by cutting off, at different seasons, portions of the same trunk or branch: but the wound thus made might, in some degree, have impeded the due progress of the sap in its ascent, and the part below might have been made heavier by the stagnation of the sap, and that above lighter by privation of its proper quantity of nutriment. The most eligible method therefore, which occurred to me, was to select and mark in the winter some of the poles of an oak coppice, where all are of equal age, and where many, of the same size, and growing with equal vigour, spring from the same stool. One half of the poles which I marked and numbered were cut on the 31st of December, 1803, and the remainder on the 15th of the following May, when the leaves were nearly half grown. Proper marks were put to distinguish the winter-felled from the summer-felled poles, the bark being left on all, and all being placed in the same situation to dry.

In the beginning of August I cut off nearly equal portions from a winter and summer-felled pole, which had both grown on the same stool; and both portions were then put in a situation where, during the seven succeeding weeks, they were kept very warm by a fire. The summer-felled wood was, when put to dry, the most heavy; but it evidently contained much more water than the other, and, partly at least, from this cause, it contracted much more in drying. In the beginning of October both kinds appeared to be perfectly dry, and I then ascertained the specific gravity of the winter-felled wood to be 0.679, and that of the summer-felled wood to be 0.609; after each had been immersed five minutes in water.

This difference of ten *per cent.* was considerably more than I had anticipated, and it was not till I had suspended and taken off from the balance each portion, at least ten times, that I ceased to believe that some error had occurred in the experiment; and indeed I was not at last satisfied till I had ascertained by means of compasses adapted to the measurement of solids, that the winter-felled pieces of wood were much less than the others which they equalled in weight.

The pieces of wood, which had been the subjects of these experiments, were again put to dry, with other pieces of the same poles, and I yesterday ascertained the specific gravity of both with scarcely any variation in the result. But when I omitted the medullæ and parts adjacent to it, and used the layers of wood which had been more recently formed, I found the specific gravity of the winter-felled wood to be only 0.583, and that of the summer-felled to be 0.533; and trying the same experiment with similar pieces of wood, but taken from poles which had grown on a different stool, the specific gravity of the winter-

winter-felled wood was 0.588, and that of the summer-felled 0.534.

It is evident that the whole of the preceding difference in the specific gravity of the winter and summer-felled wood might have arisen from a greater degree of contraction in the former kind, whilst drying; I therefore proceeded to ascertain whether any given portion of it, by weight, would afford a greater quantity of extractive matter, when steeped in water. Having therefore reduced to small fragments 1000 grains of each kind, I poured on each portion six ounces of boiling water; and at the end of twenty-four hours, when the temperature of the water had sunk to 60°, I found that the winter-felled wood had communicated a much deeper colour to the water in which it had been infused, and had raised its specific gravity to 1.002. The specific gravity of the water in which the summer-felled wood had, in the same manner, been infused was 1.001. The wood in all the preceding cases was taken from the upper parts of the poles, about eight feet from the ground.

Having observed, in the preceding experiments, that the sap of the sycamore became specifically lighter when it had continued to flow during several days from the same incision, I concluded that the alburnum in the vicinity of such incision had been deprived of a larger portion of its concrete or inspissated sap than in other parts of the same tree: and I therefore suspected that I should find similar effects to have been produced by the young annual shoots and leaves; and that any given weight of the alburnum in their vicinity would be found to contain less extractive matter than an equal portion taken from the lower parts of the same pole, where no annual shoots or leaves had been produced.

No

No information could in this case be derived from the difference in the specific gravity of the wood; because the substance of every tree is most dense and solid in the lower parts of its trunk: and I could on this account judge only from the quantity of extractive matter which equal portions of the two kinds of wood would afford. Having therefore reduced to pieces several equal portions of wood taken from different parts of the same poles, which had been felled in May, I poured on each portion an equal quantity of boiling water, which I suffered to remain twenty hours, as in the preceding experiments: and I then found that in some instances the wood from the lower, and in others that from the upper parts of the poles, had given to the water the deepest colour and greatest degree of specific gravity; but that all had afforded much extractive matter, though in every instance the quantity yielded was much less than I had, in all cases, found in similar infusions of winter-felled wood.

It appears, therefore, that the reservoir of matter deposited in the alburnum is not wholly exhausted in the succeeding spring: and hence we are able to account for the several successions of leaves and buds which trees are capable of producing when those previously protruded have been destroyed by insects, or other causes; and for the extremely luxuriant shoots, which often spring from the trunks of trees, whose branches have been long in a state of decay.

I have also some reasons to believe, that the matter deposited in the alburnum remains unemployed in some cases during several successive years: it does not appear probable that it can be all employed by trees which, after having been transplanted, produce very few leaves, or by those which produce neither blossoms nor fruit. In making experiments in 1802, to ascertain the manner in which

which the buds of trees are reproduced, I cut off in the winter all the branches of a very large old pear-tree, at a small distance from the trunk; and I pared off, at the same time, the whole of the lifeless external bark. The age of this tree, I have good reasons to believe, somewhat exceeded two centuries: its extremities were generally dead; and it afforded few leaves, and no fruit; and I had long expected every successive year to terminate its existence. After being deprived of its external bark, and of all its buds, no marks of vegetation appeared in the succeeding spring, or early part of the summer: but in the beginning of July numerous buds penetrated through the bark in every part, many leaves of large size every where appeared, and in the autumn every part was covered with very vigorous shoots, exceeding, in the aggregate, two feet in length. The number of leaves which in this case sprang at once from the trunk and branches appeared to me greatly to exceed the whole of those which the tree had borne in the three preceding seasons; and I cannot believe that the matter which composed these buds and leaves could have been wholly prepared by the feeble vegetation and scanty foliage of the preceding year.

But whether the substance which is found in the alburnum of winter-felled trees, and which disappears in part in the spring and early part of the summer, be generated in one or in several preceding years, there seem to be strong grounds of probability, that this substance enters into the composition of the leaf: for we have abundant reason to believe that this organ is the principal agent of assimilation; and scarcely any thing can be more contrary to every conclusion we should draw from analogical reasoning and comparison of the vegetable with the animal economy, or in itself more improbable, than that the leaf, or any other organ, should singly prepare and assimilate

milate immediately from the crude aqueous sap, that matter which composes itself.

It has been contended * that the buds themselves contain the nutriment necessary for the minute unfolding leaves: but trees possess a power to reproduce their buds, and the matter necessary to form these buds must evidently be derived from some other source: nor does it appear probable that the young leaves very soon enter on this office: for the experiments of Ingenhouz prove that their action on the air which surrounds them is very essentially different from that of full grown leaves. It is true that buds in many instances will vegetate, and produce trees, when a very small portion only of alburnum remains attached to them; but the first efforts of vegetation in such buds are much more feeble than in others to which a larger quantity of alburnum is attached, and therefore we have, in this case, no grounds to suppose that the leaves derive their first nutriment from the crude sap.

It is also generally admitted, from the experiments of Bonnet and Du Hamel, which I have repeated with the same result, that in the cotyledons of the seed is deposited a quantity of nutriment for the bud, which every seed contains; and though no vessels can be traced † which lead immediately from the cotyledons to the bud or plumula, it is not difficult to point out a more circuitous passage, which is perfectly similar to that through which I conceive the sap to be carried from the leaves to the buds, in the subsequent growth of the tree; and I am in possession of many facts to prove that seedling trees, in the first stage of their existence, depend entirely on the nutriment afforded by the cotyledons; and that they

* Thomson's Chemistry. † Hedwig.

are

are greatly injured, and in many instances killed, by being put to vegetate in rich mould.

We have much more decisive evidence that bulbous and tuberous rooted plants contain the matter within themselves which subsequently composes their leaves; for we see them vegetate even in dry rooms, on the approach of spring; and many bulbous-rooted plants produce their leaves and flowers with nearly the same vigour by the application of water only, as they do when growing in the best mould. But the water in this case, provided that it be perfectly pure, probably affords little or no food to the plant, and acts only by dissolving the matter prepared and deposited in the preceding year; and hence the root becomes exhausted and spoiled: and Hassenfratz found that the leaves and flowers and roots of such plants afforded no more carbon than he had proved to exist in bulbous roots of the same weight, whose leaves and flowers had never expanded.

As the leaves and flowers of the hyacinth, in the preceding case, derived their matter from the bulb, it appears extremely probable that the blossoms of trees receive their nutriment from the alburnum, particularly as the blossoms of many species precede their leaves: and, as the roots of plants become weakened and apparently exhausted, when they have afforded nutriment to a crop of seed, we may suspect that a tree, which has borne much fruit in one season, becomes in a similar way exhausted, and incapable of affording proper nutriment to a crop in the succeeding year. And I am much inclined to believe that were the wood of a tree in this state accurately weighed, it would be found specifically lighter than that of a similar tree, which had not afforded nutriment to fruit or blossoms in the preceding year or years.

 If

If it be admitted, that the substance which enters into the composition of the first leaves in the spring is derived from matter which has undergone some previous preparation within the plant, (and I am at a loss to conceive on what grounds this can be denied, in bulbous and tuberous rooted plants at least,) it must also be admitted that the leaves which are generated in the summer derive their substance from a similar source; and this cannot be conceded without a direct admission of the existence of vegetable circulation, which is denied by so many eminent naturalists. I have not, however, found in their writings a single fact to disprove its existence, nor any great weight in their arguments, except those drawn from two important errors in the admirable works of Hales and Du Hamel, which I have noticed in a former memoir. I shall therefore proceed to point out the channels through which I conceive the circulating fluids to pass.

When a seed is deposited in the ground, or otherwise exposed to a proper degree of heat and moisture, and exposure to air, water is absorbed by the cotyledons, and the young radicle or root is emitted. At this period, and in every subsequent stage of the growth of the root, it increases in length by the addition of new parts to its apex, or point, and not by any general distension of its vessels and fibres; and the experiments of Bonnet and Du Hamel leave little grounds of doubt, but that the new matter which is added to the point of the root descends from the cotyledons. The first motion therefore of the fluids in plants is downwards, towards the point of the root; and the vessels which appear to carry them are of the same kind with those which are subsequently found in the bark, where I have, on a former occasion, endeavoured to prove that they execute the same office.

In

In the last spring I examined almost every day the progressive changes which take place in the radicle emitted by the horse chesnut: I found it, at its first existence, and until it was some weeks old, to be incapable of absorbing coloured infusions, when its point was taken off, and I was totally unable to discover any alburnous tubes, through which the sap absorbed from the ground, in the subsequent growth of the tree, ascends: but when the roots were considerably elongated, alburnous tubes formed; and as soon as they had acquired some degree of firmness in their consistence, they appeared to enter on their office of carrying up the aqueous sap, and the leaves of the plumula then, and not sooner, expanded.

The leaf contains at least three kinds of tubes; the first is what, in a former paper, I have called the central vessel, through which the aqueous sap appears to be carried, and through which coloured infusions readily pass, from the alburnous tubes into the leaf stalk. These vessels are always accompanied by spiral tubes, which do not appear to carry any liquid: but there is another vessel which appears to take its origin from the leaf, and which descends down the internal bark, and contains the true or prepared sap. When the leaf has attained its proper growth, it seems to perform precisely the office of the cotyledon; but being exposed to the air, and without the same means to acquire, or the substance to retain moisture, it is fed by the alburnous tubes and central vessels. The true sap now appears to be discharged from the leaf, as it was previously from the cotyledon, into the vessels of the bark, and to be employed in the formation of new alburnous tubes between the base of the leaf and the root. From these alburnous tubes spring other central vessels and spiral tubes, which enter into, and possibly give existence to, other leaves; and thus, by a repetition of the same process, the young tree or annual shoot continues to

 acquire

acquire new parts, which apparently are formed from the ascending aqueous sap.

But it has been proved by Du Hamel, that a fluid, similar to that which is found in the true sap vessels of the bark, exists also in the alburnum, and this fluid is extremely obvious in the fig, and other trees, whose true sap is white, or coloured. The vessels which contain this fluid in the alburnum are in contact with those which carry up the aqueous sap; and it does not appear probable that, in a body so porous as wood, fluids so near each other should remain wholly unmixed. I must therefore conclude, that when the true sap has been delivered from the cotyledon or leaf into the returning, or true sap vessels of the bark, one portion of it secretes through the external cellular, or more probably glandular substance of the bark, and generates a new epidermis, where that is to be formed; and that the other portion of it secretes through the internal glandular substance of the bark, where one part of it produces the new layer of wood, and the remainder enters the pores of the wood already formed, and subsequently mingles with the ascending aqueous sap; which thus becomes capable of affording the matter necessary to form new buds and leaves.

It has been proved, in the preceding experiments on the ascending sap of the sycamore and birch, that that fluid does not approach the buds and unfolding leaves in the spring, in the state in which it is absorbed from the earth: and therefore we may conclude that the fluid which enters into, and circulates through the leaves of plants, as the blood through the lungs of animals, consists of a mixture of the sap or blood of the plant with matter more recently absorbed, and less perfectly assimilated.

It appears probable that the true sap undergoes a considerable change on its mixture with the ascending aqueous sap; for this fluid in the sycamore has been proved

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to become more sensibly sweet in its progress from the roots in the spring, and the liquid which flows from the wounded bark of the same tree is also sweet; but I have never been able to detect the slightest degree of sweetness in decoctions of the sycamore wood in winter. I am therefore inclined to believe that the saccharine matter existing in the ascending sap is not immediately, or wholly, derived from the fluid which had circulated through the leaf in the preceding year; but that it is generated by a process similar to that of the germination of seeds, and that the same process is always going forward during the spring and summer as long as the tree continues to generate new organs. But, towards the conclusion of the summer, I conceive that the true sap simply accumulates in the alburnum, and thus adds to the specific gravity of winter-felled wood, and increases the quantity of its extractive matter.

I have some reasons to believe that the true sap descends through the alburnum as well as through the bark, and I have been informed that if the bark be taken from the trunks of trees in the spring, and such trees be suffered to grow till the following winter, the alburnum acquires a great degree of hardness and durability. If subsequent experiments prove that the true sap descends through the alburnum, it will be easy to point out the cause why trees continue to vegetate after all communication between the leaves and roots, through the bark, has been intercepted: and why some portion of alburnous matter is in all trees * generated below incisions through the bark.

* I have in a former paper stated that the perpendicular shoots of the vine form an exception. I spoke on the authority of numerous experiments; but they had been made late in the summer; and on repeating the same experiments at an earlier period, I found the result in conformity with my experiments on other trees.

It

It was my intention this year to have troubled you with some observations on the reproduction of the buds and roots of trees; but as the subject of the paper, which I have now the honour to address to you, appeared to be of more importance, I have deferred those observations to a future opportunity; and I shall at present only observe, that I conceive myself to be in possession of facts to prove that both buds and roots originate from the alburnous substance of plants, and not, as is, I believe, generally supposed, from the bark.

Description of an improved Repeating Watch, having neither Pinions, Pullies, Chain, nor Racks. Invented by Mr. J. M. Elliot, *Aylesbury Street, Clerkenwell.*

With a Plate.

From the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce.

A Bounty of Thirty Guineas was voted to Mr. Elliot *for this Invention.*

HAVING for some years had in contemplation repeating watches, and considering the great expense in the first purchase, and the continual expense of repairs, I was induced to turn my thoughts to the subject, in order, if possible, to reduce them to a much simpler principle, and prices considerably lower; and from models that I have frequently made, and experiments upon them, I flatter myself that I have made several useful improvements thereon. It is well known, that repeating watches have always been, and are at this time, in the hands of few, and in such hands they appear to me more for show and ornament than of any real use; but the middling

class

class of mankind, to whom they are of the most service, are deprived of their benefits. From motives of this kind, the model, the result of my labour, and one upon my last-improved plan, are sent for the inspection of the Society of Arts, and for the good of the public.

The method of using the new repeater is as follows:— Hold the watch in the left hand, and apply the finger and thumb to the pendant; and if it is required to repeat the hour, turn it to the right, till it gives a full stop. But if it is to repeat the quarter, turn the pendant to the left, till it gives a full stop, as in winding up a common watch.

In the last place, I shall give a comparative view of the superiority of these new repeaters to the old ones, for the interval of twenty years.

	£.	s.	d.
The expense of the old repeater, in the purchase - - - - - - - - - - - - -	30	0	0
Cleaning at half-a-guinea *per* year, for twenty years - - - - - - - - - - - - -	10	10	0
Total amount - - -	£.40	10	0

	£.	s.	d.
The expense of the new repeater in the purchase - - - - - - - - - - - - -	8	8	0
Cleaning at 5*s.* *per* year, for twenty years -	5	0	0
Total amount - - -	£.13	8	0

Which makes a saving to the purchaser of	£ 27	2	0

Perhaps

Perhaps it may be observed by some mechanical gentlemen, that the model under consideration is not finished in so superb a manner as might have been expected; but, in order to obviate every difficulty that may arise, I shall only say, that it is not exhibited as a fine piece of workmanship, but as a piece of mechanism; and, as such, I have taken the liberty of laying it before the Society for the Encouragement of Arts, &c. trusting that they will allow it as much merit as it deserves.

The drawing represents the repeating watch with the last improvement, which is upon a much simpler principle than the model deposited with the Society; as I have entirely got rid of the system of parts contained between the plates. I need not expatiate on its utility, that being fully explained in the drawing annexed. My repeating movements can be added to an old watch for the sum of three guineas, if it is to be a dumb repeater. With a farther addition of three guineas, I can furnish my repeating-work with a bell and new metal cases.

Reference to the Engraving of Mr. Elliot's Repeating Watch, Plate III. Figs. 1 and 2.

Fig. 1. Let A B represent the pillar-plate, *viz.* its upper side. C D a circle of steel, moving freely in the steel pullies E F G H. This steel wheel is put in motion by means of a small wheel *a*, fast on the axis, which goes through the pendant, which acts in the teeth on the under side of the circle represented by the dotted arch *b*. I, is the quarter-snail. K, the minute-wheel. The hour-wheel may easily be supposed, therefore requires no description. L, is part of the hour-snail, which is not drawn complete, by reason that it would intercept the view of the rack of the steel circle at Q. O, is the locking

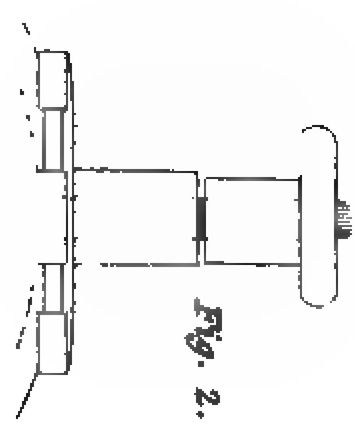

Fig. 2.

ing-lever. P, the end which falls upon the hour-snail, to regulate the number of strokes it is to strike; at the same time the end Q of the lever O locks into one or other of the notches in the steel circle. The star-wheel, No. 1, is rivetted or screwed to the hour-snail, and moved by the small arm No. 2, on the canon pinion. M and N are the jumper and spring. R is the quarter-locking lever. S, the end that falls upon the quarter-snail. T, the locking end, which locks into the notches *h*. At X is a pin in the steel circle, to which is hooked a chain, and the other end of the barrel V. This chain, when the pendant is put in motion, will unwind from the barrel, and, by acting between the steel rollers U W, will work both to the right and left. *i k*, are small pallets, on which are the tails of the hammers, acted upon by the pins, as *per* figure; so that, at the end of the strokes that have struck, the spring in V will draw back the steel circle, and the pins will pass by the hammer-tail, and a small spring under *l* will bring it into its proper place.

Example.

I hold the watch in my left hand, and with the right I turn the pendant to the left, to strike the hour. The point P will fall on some part of the hour-snail; at the same time the point Q will stop the steel circle. The hammer of course will give the hour. The same is to be understood of the quarters; only observe to turn to the right.

Fig. 2 explains, by similar letters, in another view, the same parts of the watch, in order that its construction may be more easily comprehended.

Experiments and Observations on the fining and clarifying of Wines, Malt Liquors, &c. By M. PARMENTIER.

From the ANNALES DE CHIMIE.

THE general views which I have given in the *Annales de Chimie** (30th Thermidor, year 9, p. 113) respecting the different methods of proceeding for the clarification of liquors, and the influence of this operation in the chemical and pharmaceutical arts, induce me at present to make an immediate application of the knowledge which we possess upon this subject to domestic economy.

My design is not to examine, in detail, all the different processes which have been indicated and recommended for clearing wines. I shall only observe, that, in order to unite the heterogeneous particles dispersed in a liquid which we intend to clarify, we must not expose ourselves to the risk of altering its composition, a circumstance very likely to have occurred when it was necessary to grope one's way among the multitude of agents which were formerly recommended for this purpose, although neither their nature nor their mode of operation was at that time known. Among these I shall mention but one; namely sand, well washed and of great purity, because being insoluble, it could not communicate any foreign taste to the wines; though, in fact, its utility is confined to those cases in which they require only to be freed from the light feculencies which generally impair its transparency: by its specific weight it carries along with it whatever it meets in its passage, and sinks down with it into the lees.

It is chiefly with wine that great use is made of albumen after the racking from the lees, and some days be-

* See the first series of this work, vol. XVI. p. 130.

fore

fore putting it into the bottle: in this case it is sufficient to beat up white of eggs with water, and to add them by the bung-hole, moving them with the wine by agitation. Soon after this has been done a kind of net-work is seen to form in the liquor, which, concentrating itself together, colleets all the heterogeneous matters, and carries them along with it to the bottom of the vessel.

A fact which proves that the white wines may equally well be clarified with albumen, is, that the inhabitants of the western and some of the southern provinces of France employ no other means for this operation, and that, according to the returns for the district of Bourdeaux, this town consumes annually, for that purpose alone, nearly fifteen millions of eggs, whilst in the northern departments the whites of eggs are employed exclusively for the red wines, it being imagined that for clarifying the white wines the use of fish-glue cannot be dispensed with. The information which I have been able to collect from the dealers of different departments has not yet been sufficient to explain to me the reasons upon which this distinction is grounded; and it seems even, from the vague and unsatisfactory answers which I have received to my inquiries, that this practice depends entirely upon local custom. We shall hereafter have occasion to speak on this subject.

But if albumen completely answers its purpose of clarifying wines, whatever this colour may be, it must however be admitted that their agent is not always exempt from some inconveniencies, and that notwithstanding the precautions which are generally recommended, to use only fresh-laid eggs, to examine them, to break them one by one into a particular vessel, it has sometimes happened that, in consequence of an egg having been used which had began to suffer alteration, the perfume and flavour of the wines have been spoiled or destroyed.

 I have

I have seen with a friend of mine, whose cellar was left to the management of careless domestics, a quantity of wine which had entirely the flavour of an egg which, to use the common expression, tastes of the straw; and how common is it not to blame the casks, the cellar, the soil, when wine has any peculiar flavour which it ought not to have. This flavour proceeds frequently from nothing else than that the wine has been clarified by means of eggs, among which there was a single spoilt one; and every one knows that in this state it is able to produce a very disagreeable alteration in the taste of made dishes, pastry, custards, &c.

But, it may be replied, this inconvenience may always be obviated by taking care to employ only fresh eggs. This indeed may easily be done in the spring and till in the autumn, because during that portion of the year all the eggs generally sold are tolerably new: the country people bring them twice a week to the town-markets, and it is only at the second laying that they think of hoarding them up for winter provision.

The cold seasons are preferred for bottling wines, after they have previously been fined: at such times fresh eggs are rare and consequently very dear, and those exposed for sale are in general at least three months old; on which account double vigilance must be used to avoid employing eggs which can be suspected of having a taste of the straw, for frequently this degree of alteration does not become perceptible till after they have been diluted and mixed with the liquor.

However, it must be understood that when an egg is said to taste of the straw, it is because this substance is commonly employed for keeping them; for it frequently happens that a spoilt egg breaks, spills and diffuses itself in the straw, which, when once moistened, ferments and suffers alteration: otherwise the eggs, exposed

exposed to all the elements of corruption, easily undergo alteration, and pass, after a longer or shorter space of time, into that state which is generally designated by the term of having a taste of the straw, whatever the substance may be in which they have been kept.

I think I have also observed that eggs are not spoiled merely by the loss of their humidity, which occasions a repture in the equilibrium of their constituent principles, but that there exists also another cause of deterioration, which seems to have been suspected by the dealers in eggs; for long experience has taught them, that when eggs have been carried a distance of some miles, they do not keep near so well as those which have suffered no such removal. The reason of this is, that in land-carriage the eggs are exposed to concussions and sudden motions which disorganize their interior parts, break the ramifications of the vessels by which the germ was attached to the yolk, and that this germ, or chick, being deprived of the organs which supported its life, dies, and, becoming itself corrupted, communicates corruption to all that surrounds it.

When we consider that the fecundated germ may, without experiencing any preternatural accident, die, and that it is dead when kept beyond the period proper for incubation; that frequently a clap of thunder is sufficient to destroy the germ in fresh eggs, and it is known that this meteor produces a similar effect upon the embryos of eggs under incubation; can it appear improbable that the same circumstance should take place with those that are kept in the stores? and it is admitted that in organized bodies corruption commences always with the fecundated germs.

Addle eggs, incubation excepted, may answer all the other purposes for which eggs are employed; they are not

not only as nourishing and wholesome as fecundated eggs, but they also merit the preference as to their use in some processes, such, for example, as that which is the subject of the present memoir. It would undoubtedly be of great advantage to employ, for the clarification of wines, only such eggs as have been laid by hens to which the cock was not admitted; for as these do not so easily contract a bad taste, they will also communicate none to the liquors when fined and clarified; there would be no reason to dread concussions; the germ might indeed be detached from the ligaments which unite it to the yolk, but, not being fecundated, it has not the same propensity to corruption as that which has received animation; finally the means proposed for keeping it in a good condition would prove more successful. Let us now bestow some consideration on fish-glue or isinglass.

Of Isinglass, and the Substances which may be employed as Substitutes for it.

Isinglass, it is well known, is prepared from the stomach, the skin, the bladder, the intestines, dried and formed into rolls, of the large sturgeon (Accipenser huso. Linn.); but what our fishermen are too ignorant or neglectful of is, that it may be prepared equally well with almost all parts of several other kinds of fishes; for, not to mention the excellent isinglass which the Laplanders extract from several species of perch (perca Linn.), and which the Russians also prepare from all the different fishes belonging to the genus of sturgeon, isinglass is likewise prepared by boiling the skin, the intestines, previously cleaned, the air-bladder, the fins, and the membranes of sturgeons and several other kinds of fishes. When this gelative has been condensed, it is cast into plates which are afterwards formed into rolls and bent

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in the shape of a lyre, and after drying in the shade, they are introduced into commerce. Such is, according to several travellers, especially Pallas, the manner in which this glue is prepared. The English consume great quantities of it in their porter-breweries, and it is from them that the French and the other nations of the south of Europe purchase it for fining their wines. The great exportation of this article considerably augments its price. (Nouveaux Voyages de Pallas dans les parties méridionales de l'empire de Russie en 1794. Tom. I. p. 11.)

M. Lacépède, in his Natural History of Fishes, says, under the article *Accipenser:* "We may very easily imitate in Europe the processes employed by the Russians for the fabrication of a matter which forms a more important branch of commerce than is generally believed; and I can confidently assert that, particularly in France, there is scarcely a single species of fish either in our lakes or rivers of which the air-bladder and all the thin and membranous parts, are not capable of furnishing, after having been carefully cleaned and dried, a glue of as good, or at least of nearly as good, a quality as that which is brought to us from the south of Russia. It has been tried with success, and I do not need to remark at how low a price, and in what large quantities, we might have a preparation made from substances which are at present rejected in all fisheries and in all kitchens, and the use of which would by no means diminish the consumption of the other parts of the fishes."

The fishes best adapted for affording a substitute for isinglass, with their bladders, their intestines, and their skins, are chiefly those which the naturalists rank under the cartilaginous tribe. Such are the sea-dog, the seal, the skate. These fishes furnish a gelatinous gluten

gluten in great abundance and of a very tenacious quality, as is known by experience. Its colour is indeed a little darker than that of the isinglass, and it retains a slight smell of fish; but the small quantity of it which is employed either for clarifying the different liquors, or for glueing broken articles together, or for giving a shining lustre to various silk stuffs, is by no means capable of presenting any perceptible difference from isinglass.

To remove all suspicions on this subject, I shall enumerate several kinds of fish, the membranes and bladders of which afford an isinglass as good, as transparent, as free from odour and from taste, as that of the sturgeon, as appears from the trials which have been made of it.

The first is the *Mal*, a fresh-water fish, which attains a very considerable bulk, and is caught in the Rhine, the Danube, and the Wolga. It belongs to the genus of the *Siluri*, and Linnæus designates it by the name of *Siluris glanis*. Those of the Danube are generally from six to eight feet in length, and weigh about three quintals. It is a sluggish animal, that frequents muddy bottoms, though it multiplies little, and is seldom found unless attended by the female; it abounds in large rivers. Its air-bladder affords an isinglass equally good, transparent, and inodorous; hence the denomination of *isinglass-fish*, by which several naturalists have distinguished it.

In general, all those fishes which are but little covered with scales and inhabit the tranquil waters of lakes, ponds, &c. yield an extraordinary quantity of very wholesome and palatable gelatine, if care be taken to prepare it in a cleanly manner, for it will not only be transparent and inodorous like isinglass, but it will even furnish the clearest jellies; for the Tartars and the

the other semi-barbarous tribes who prepare the isinglass are known to be in general very filthy and disgusting in their habits. The fishes, which inhabit running streams with gravelly bottoms, seas in constant motion, &c. have a firmer and more fibrous flesh which presents less of the gelatinous principle; such are the species which naturalists rank under the order of the thoracic, and which inhabit the open seas. Those that frequent tranquil coasts, bays sheltered from the winds, and muddy bottoms, are very capable of furnishing from all their parts a gelatine more or less transparent and inodorous, according to the care which has been used in its preparation.

The fishes best adapted for this purpose are in the first place the Blennius Pholis Linn. which is found in the Ocean and the Mediterranean, in the midst of the weeds and in the clifts of rocks: its whole body is covered with a very abundant viscous humour, and the whole of it may be used for isinglass with the greater advantage, as very little value is otherwise placed upon its so extremely gelatinous flesh. Several other species of the same genus may easily be applied to the same purpose, such as the Blennius Ocellaris Linn. which inhabits the Mediterranean; the Blennius Phyces Linn. of the same sea, as also the Blennius galerita Linn. the flesh of which is equally gelatinous.

Secondly, if it should be feared that the number of these fish might not be sufficient for the preparation of the fish-glue which is consumed, a very abundant supply may be obtained from the cod-fish. "In the North, a glue is made from the air-bladders of cod-fish, which greatly resembles in quality that which is made from sturgeons, and which is properly termed isinglass. The method in which this operation is conducted is as

 follows;

follows; The bladders together with their ligaments are taken out, cut in two, and the first skin is taken off with a knife; they are then put into lime-water, in order to remove the fat parts which might have remained upon them, and they are dried. It has been attempted to perform the same operations upon the bank of Newfoundland, but the attempt has been relinquished because the weather and situation were frequently inconvenient; on which account the air bladders are salted there, for the purpose of eating, and they are considered as very wholesome and nourishing food." (*Bosc*, Nouveau Dictionnaire d'Histoire Naturelle. art. *Morue.*)

In such abundant fisheries as those of cod-fish it cannot fail that many parts of these fish are lost, which would be very proper for the preparation of excellent isinglass, in no respect inferior to that of the sturgeon.

Besides these, there are several other fish of the same genus as the cod, which would likewise afford good isinglass, such as the Gadus Egelfinus, Linn. so common in our Northern seas; also the Gadus Barbatus, Linn. which in the spring frequents all the northern coasts of France; the Gadus Carbonarius, Linn. and the ling (Gadus Molva, Linn.) which is caught in such large quantities, and multiples almost as much as the herring. Accordingly the inhabitants of several of the Northern countries prepare a good kind of isinglass with its air bladders, a branch of industry which is neglected by the French fishermen. The stock-fish (Gadus Merbuccius, Linn.) is also to be enumerated among those which may be employed with the greatest advantage for the preparation of isinglass, capable of rivaling that of Russia.

I shall say nothing of eels and lampreys, from the skins of which a very tenacious glue may be obtained; for nothing

thing which may be of utility should be suffered to be lost, though with us the custom is otherwise.

The cuttle-fish, and several other animals of the class of the molusca, which are caught in abundance on some maritime coasts, likewise furnish a gelatine of the best quality, which may be extracted from them, if proper care be taken to prepare it with the requisite attentions. It is with similar animal substances that the Chinese birds'-nests are formed, which afford soups so much in request and so highly nourishing in diseases of exhaustion. These birds'-nests are nothing else than a natural isinglass and other molusca, from which a sea-swallow composes its nest which it glues to the rocks. This small bird is called *Salangane* (Hirundo Aculenta, Linn.), and Kempfer asserts that a matter similar to these nests is prepared with the flesh of the polypi, &c. naturally aromatized by an odour something resembling the odour of musk, and which is the same with that of the ink ejected by the cuttle-fish of the Chinese seas when it is pursued, for the purpose of obscuring the water and thus effecting its escape. The substance of the birds'-nests is of the colour and consistence of isinglass, it is likewise capable of solution in boiling water, though with more difficulty; but the excellent flavour of these nests and the very substantial nourishment which they yield, causes them to be very much in request with the Asiatic nations; the gelatine extracted from our cuttle-fish may very advantageously supply its place.

TO BE CONCLUDED IN OUR NEXT.

Of Plaster of Paris, considered as Manure for Land, and Artificial Meadows. By *M.* PARMENTIER.

From the ANNALES DE CHIMIE.

IT is about thirty years since I considered it my duty to attack the opinion that saline matters exclusively possessed the principle that dispenses fertility to land, the power of manures, and the nourishment of vegetables. At that period, it is true, the sciences had not furnished such abundant materials as now exist for resolving the questions; I therefore took it up again in 1786 in a memoir read to the Royal Society of Agriculture, and inserted in the 11th volume of the *Annales de Chimie.* After briefly noticing all the substances that were then known to be fit for manure, I made a few observations on plaster of Paris, adding that its action might be compared to that of turf-ashes: that either of them scattered at the proper season, on the soil to which they are suited, would in certain situations surpass dung in augmenting the produce of meadows, and particularly artificial meadows. But before we assert that any substance whatever possesses the properties of manure, we should always take the precaution to ascertain the nature of the soil on which it is proposed to be spread, and the kind of crop that is intended to be raised on it; and by means of this knowledge we determine the proportions, the form, and the time that must be favourable to its action. How many substances are there, which taken separately have a quality the reverse of fertilizing, and which, by their combination, form a powerful manure.

The use of plaster of Paris in the construction of buildings, either to unite the different parts or to communicate to the surface a brilliant white colour, has been

been known from time immemorial. Sculptors employed it formerly, as at the present day, for making their models, and antiquaries to fix in it the impressions of the objects of their learned curiosity: but plaster of Paris is interesting in a very different point of view, to agriculture, though it was not till about the middle of the last century that it was first applied to the purposes of manure. Its use in that quality has been so extended and propagated, that it has even been introduced into the new world, and the Americans have transported it from Paris to try its effects on their soil, the produce of which it has augmented. Finally Kirwan, to whom we are indebted for an excellent memoir on manures, considers plaster of Paris as the most powerful of them all.

Qualities of Plaster of Paris.

Nature presents us with gypsum or sulphate of lime, and art converts it into plaster. One is a real salt blended with more or less calcareous carbonate; the other is the same mixture deprived by calcination of the water of crystallization, and a portion of which is reduced to the state of lime.

It is therefore necessary not to confound them, but to specify the quality of the plaster of which we speak. That which has been baked or burned may be kept many months in a dry place without inconvenience; for it has not yet been demonstrated, that when it becomes stale (as it is tritely called) it loses the properties which render it so valuable for the improvement of land. It is well known that in this state it is unfit for building, excepting, like slaked lime, it be again subjected to calcination; but supposing that its effects as manure are not so powerful, we cannot forbear thinking that they must be highly analogous.

Many

Many facts attest that plaster in its rude state, that is, gypsum in the state in which it is taken from the pit, when very friable, may perform the purposes of a manure; but it acquires infinitely greater energy by being baked or calcined, and afterwards pulverised, operations indispensably necessary for its being used on land and for producing the desired effect. The first may be executed every where with the greater facility, as in those situations, where it would be rendered impracticable by the high price of wood, it may be effected equally well by means of turf or coal, which in this instance is even regarded as preferable. The second relates to the division of the plaster, for which a mill must be employed, as that method is infinitely more expeditious than manual labour. The general police, whose duty it is to watch over the preservation of human lives, particularly those of the labouring classes, ought to prohibit this operation from being performed by the hand, as productive of dangerous consequences. The saline and earthy particles diffused through the air, continually respired by those who break the plaster, insensibly lead to fatal obstructions of the lungs, which considerably abridge their days. Recourse should therefore be had to mills, which are devoted to this use in some of the cantons of France.

Plaster, which has for ages been used for the construction of buildings, and is known by the denominations of rubbish, would be more useful than gypsum, either in its rude state or calcined, because, though it has lost the property of being convertible into cement, yet new combinations have been formed in it, of saline, deliquescent matters, capable of drawing the humidity of the atmospheric air and transmitting it in an advantageous manner to the plants.

Gypsum,

Gypsum, whether in its rude state or calcined, varies in form and composition. The physical knowledge of this manure should not be a matter of indifference even to the mere farmer; as it would continually help to direct him how to employ it, and would enable him to procure it, in places to which it had been denied by nature, by an artificial combination of the different principles that constitute this manure: for however abundant gypsum may be in nature, it is by no means so plentiful as marl and lime-stone.

Of the use of Gypsum.

The inhabitants of districts in the vicinity of quarries of gypsum have no hesitation to attribute to its operation their beautiful artificial meadows, and the rich crops they yield, as well as the improved condition of the cattle that cover them: there can be no fine clover without gypsum, and no good crop of corn if it be not preceded by a good crop of clover. Such is the opinion of the most skilful farmers who have employed gypsum. For the rest, those who wish for circumstantial information concerning the best methods of employing this manure and the benefits resulting from its use, will find in the Annals of French Agriculture for the year 1803, by our colleague Tessier, a very interesting historical notice on plaster.

Gypsum has likewise obtained great reputation as a manure in Italy. Giacomello has stated the result of his labours with this substance in a memoir which contains the rules for its preparation and employment. The English have likewise eagerly adopted the use of plaster in every part of their island, and all the trials they have undertaken have been crowned with complete success. It is well known that the Society for the encourage-

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ment of Arts, &c. of London generally grants a premium of one hundred guineas to every person that discovers a new manure.

Young's experiments are so striking, that he prefers gypsum to every other kind of manure and even to pigeon's dung. That celebrated agriculturist indeed confined the use of it to clover-lands; but it may not be amiss to observe, that in England gypsum is common as lime-stone, and that the latter, when converted into lime, is equally proper for ameliorating strong and humid lands, which so generally constitute the soil of that kingdom, that there is no necessity to seek for a better.

It would be difficult to determine with precision the quantity of plaster that ought to be employed, since it must vary in proportion to the lime it contains. The mean proportion is one pound for four square fathoms, but the quantity must be increased for certain species of vegetables; for instance, plaster is of very great advantage to lucerns, saintfoin, flax and leguinous seeds, but of very little to hemp, and to damp and marshy meadows. The plant to whose vegetation it is particularly favourable is clover, which, with this manure, grows to a greater height, is of a darker and more brilliant green, and its leaves are much larger and thicker.

It cannot be doubted that the proportions of the plaster have some influence on its effects. Mr. Sageret, who has employed it on a large scale, in different ways, on artificial meadows, has constantly obtained favourable results. He at first laid on a few perches of his lucern and saintfoin a bag of about sixty pounds to each perch; the effects were perceptible the third year. Wishing to be more frugal of manure he confined himself to twenty bags per acre *. The land without plaster produced 80

* A French acre contains 100 square perches of 18 feet each.

trusses

trusses of saintfoin each weighing ten pounds, whereas the acre which had been treated with that manure yielded 120 trusses more. The crop of lucern was exactly in the same proportion; so that the benefits resulting from it may very easily be appropriated.

It is equally certain that plaster, which saves tillage and dung, has introduced artificial meadows into districts where they were unknown: though its effects are somewhat diminished the second year, it still produces excellent crops. It may be sprinkled in spring or autumn; if the operations be performed in spring, it produces no effect till the second crop.

The seasonable moment for employing the plaster must likewise be considered, if we wish to obtain from it all that it is capable of producing. Autumn and spring are the most favourable seasons; it does not mingle with soil which has recently been improved. It is sprinkled at random, in the same manner as corn is sown, so as lightly to cover the whole surface of the soil. It should not be spread when the wind is high, because in this case the particles are unequally dispersed and are often carried off the ground, or collected in too great quantity on one spot; so that certain parts of the field have too great a proportion, which is prejudicial, while others have too little. It likewise appears to have been proved that, if after it has been spread neither dew nor rain succeeds, its effect is scarcely perceptible. It is therefore desirable that this operation should always be performed at the approach of an abundant dew or a moderate rain.

By several accurate experiments it has been ascertained that about the same quantity of plaster as of seed should be sprinkled on a given surface. This proportion, supposing it to be founded on multiplied and varied

 experiments,

experiments, as my colleague Tessier judiciously observes, would fix a very convenient rule. Thus for an acre, on which eight bushels of wheat, Paris measure, are commonly sown, eight bushels of plaster would likewise be required.

It cannot be denied that the state of division of the plaster at the moment when it is employed has some influence over its effects. Giacomello advises that it should merely be broken when it is intended to be spread on natural meadows; to pulverize still more that which is destined to promote the vegetation of beans, pease, vetches, and all plants which are cut but once; to reduce it to a still finer powder for strong, clayey soils; and lastly, for artificial meadows to mix it with dung or earthy substances, which produce more effect than if each of those matters was separately employed.

The celebrated professor Arduino has stated with equal accuracy and precision the result of the varied and multiplied experiments he made with plaster; he ascertained that eight pounds, on a surface of 36 square fathoms, triple the crops of clover and vetches; and like Giacomello, he is of opinion that this manure ought always to be sprinkled on the surface of the ground.

We have already seen that the effects of plaster depend not only on the nature and quality of that substance, and the species of plants which are to be grown, but likewise on the season when it ought to be applied, on the state of division it ought to have, and on the precautions necessary for sprinkling it in a uniform manner. We shall now prove that it is the nature of the soil which must in a particular manner regulate its use and determine its efficacy.

The principal point is, to make use of it soon after its extraction from the quarry, its calcination, or exposure to the air, when in the form of rubbish. Under all these

these circumstances this mineral manure undergoes modifications which must necessarily have an influence over its efficacy and its mode of action. In giving an account of experiments made with plaster, we ought, therefore, to distinguish with accuracy the different states in which it may be, whether unburned, burned, or having been employed for building.

Effects of Plaster on Land.

The efficacy of plaster applied to exhausted soils and to languishing plants, to improve and revive them, is now beyond any doubt. But it does not appear that opinions are equally unanimous concerning its real manner of acting.

Like all other manures, plaster exercises two-fold action on land: it may at first operate mechanically, and afterwards exercise all the functions of ferment or yeast, to furnish all the gases favourable to vegetation. It contains, and in particular that which is newly baked, calcareous sulphur completely formed: the materials for spontaneously forming new ones exist in unbaked gypsum, which may account for the success obtained in Italy by mixing a small quantity of sulphur with the plaster, whence results a combination which renders it more proper for refining the humidity of the air. Perhaps this addition on lands purely calcareous would be a powerful method of rendering them fertile, if unbaked plaster or gypsum were employed; but this mixture is not practicable except in the vicinity of volcanoes.

An opinion very generally adopted by agriculturists is that mineral substances are the best manures which can possibly be employed when they are applied with intelligence and moderation, because, in the first place their effects are infinitely more durable; many of them

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exercising a beneficial influence for 15 or 20 years; and in the next place, they do not introduce into the ground, like dung, either the seeds of parasitical plants, or the eggs of those insects, which when developed, gnaw the roots and destroy the vegetables, or lastly those modifications of smell and taste by which the nature of the manures employed may often be distinguished. It is true their action is less speedy and powerful than that of putrefied animal and vegetable substances.

Among the mineral substances from which agriculture may derive advantage as manures, there exists none more natural for light lands than clay, or for compact and stubborn soils than sand, and both under these circumstances act mechanically. It was this that, when speaking of that arid portion of the province of Champagne, caused me to assert, that, supposing its chalky soil rested on a bottom of clay, the latter ought to be worked like a mine, by means of which the country would soon be rendered fit for cultivation, and would present to the eye of the traveller a less melancholy spectacle.

Unbaked gypsum seems to act nearly in the same manner as lime, when, like that substance, it is mixed with a clayey soil, for the purpose of improving and rendering it less tenacious, after mild and wet winters; but it is more particularly advantageous when spread on a field of clover, or on other plants that are weakened or choaked by the excessive growth of weeds, mixed in different proportions with dung. This composition has a powerful effect; on the other hand, it may easily be conceived that if a field of clover or lucern lay near a pit of gypsum, the method of improving those meadows would be by a clayey marl, or some manure of the same nature.

When the soil is too substantial, it may easily be impoverished by repeated crops, and by the culture of

certain

certain plants; but it is not always because the soil is overloaded with manure that the latter fails of producing the desired effect; it is frequently on account of the bad choice that is daily made. If, by nature, any manure is analogous to the soil it is intended to improve, if it possesses the same properties, the result of such a mixture cannot possibly produce any advantage. Thus, for instance, if argillaceous marl be spread on a clayey soil, or plaster on calcareous land, or ashes on sand, or saline substances on fields situated at a short distance from the sea, this would doubtless be only adding one defect to another. Yet those who proceed in this way without method or reason conclude by vaguely asserting that plaster, ashes, marl and saline matters are not manures, because they have produced effects contrary to what were expected; though the efficacy of all those substances employed at seasonable times and in proper places, in suitable forms and proportions, is no longer problematical.

One very extraordinary circumstance is, that gypsum, whether baked or in its original state, does not seem to be productive of benefit to rich and fertile lands, and that its effects are much more perceptible in gravelly and strong soils, and in low, marshy meadows, where it agglomerates and is with difficulty decomposed; nor is it more successful on soils of a similar nature with itself. It is possible that there may exist other causes besides the nature of the soil, to which the failure of plaster tried as manure might be attributed; but this examination would lead us too far. It is sufficient for our purpose to know, that calcareous soils, which, in general, partake much of the nature of plaster, are incapable of receiving any benefit from that manure: and it cannot but be surprising that authors have spoken highly of plaster

plaster for land of that quality. The component parts and a multitude of facts contradict this opinion, and demonstrate how necessary it is for the agriculturist to be on his guard relative to the assertions of writers who lightly pronounce after a single experiment on a small scale, which they have not the courage or the patience to repeat before they run the risk of propagating an error.

According to some observations, plaster when spread on clover, preserves the succeeding crop of corn from the worms which commonly swarm in soils where it is cultivated. It possesses the additional advantage that it is prejudicial to the developement of rushes and weeds, and in their stead produces clover, even without being sown. Under these different circumstances plaster is not only a powerful manure; it is likewise an enemy to the aquatic plants which overrun our meadows, and the insects that devour the crops.

Now that we are no longer in uncertainty as to the efficacy of gypsum, when judiciously employed, farmers who are situated in the vicinity of pits of that substance, and who have lands susceptible of being improved by it, cannot be too strongly advised not to neglect to take advantage of such a source of fecundity; to vary the manner of its employment, and at the same time to make comparative experiments between it and other earthy substances as well as manures derived from the two other kingdoms of nature. It can only be by multiplying experiments and observations that we can enable ourselves to appreciate the real utility of plaster and its true manner of acting on plants; to render certain soils fit for artificial meadows; to expose by degrees the ridiculous system of fallows, against which I have never ceased to inveigh.

Let

Let us not, above all things, lose sight of this truth, that, in a multitude of circumstances, the action of manures is very similar to that of medicines; and that, consequently, they cannot be adapted to lands of every quality and in every situation. They are principally either tonics or relaxing, according to their nature and the case which causes them to be employed; care must therefore be taken not to generalize them too much. He who, to extol any manure, should pretend that it is possible to employ it with equal success for arable land, meadows, vineyards, kitchen-gardens, orchards, and nurseries, would run the risk of being classed among those quacks, who, without regard to climate and local circumstances daily bring into disrepute the best method of cure by applying it indiscriminately to all ages and constitutions.

It must be admitted, that the philosophy of vegetables still wants a series of experiments and researches proper for conciliating the two opinions on the influence of vegetation; one of which attributes every thing to manures and the soil, the other to water, aëriform fluids, caloric and alumine. Mr. Maurice, in his work on manures, points out to those who wish to obtain a thorough knowledge of this subject the sources it is necessary to consult, and what still remains to be done towards the complete solution of the problem; supposing that it is not in the number of those which it is not granted to human powers to resolve.. Perhaps there are manures applied to the soil and to plants, like medicines, and we shall long be obliged to reply like Moliere: they fertilize the land because they possess a fertilizing quality. Let us multiply the number of manures; let us bring to perfection the mode of their application; let us, in fine, imitate the physicians, who, in a multitude of instances, have the honesty to admit that their treatment and cures are merely empirical.

Extract

Extract of a Memoir by Dr. J. B. Richter, *on the Purification of Cobalt and Nickel, and on the Separation of those two Metals on a large Scale.* —*By* F. A. Oezel.

From the Annales de Chimie.

In the introduction to this memoir, Dr. Richter says, that ten years ago the purification of cobalt had led him to many interesting experiments. The ores of cobalt which he then possessed contained only iron and bismuth; he has often separated the iron by arseniate of potash: but this operation often failed of success, because it depends much on the state of saturation in which one or other of the metals may be with the solvent, and on the temperature.

He has for some time observed that the separation of the iron and the bismuth is not sufficient for the cobalt, because the ore he now employs contains, besides those substances, some copper, and a great quantity of nickel. As these two metals are very prejudicial to the blue colour of cobalt, the author has endeavoured to discover a method of separating them from it. He says that M. Hermbstädt communicated to him a process for separating the cobalt from the nickel by means of pure ammoniac; but as that substance is too expensive to be used on a large scale, he applied himself to seek some other material that might be employed in its stead.

After this introduction, Dr. Richter describes the process which he found the most advantageous for separating, particularly on a large scale, the metals mixed with the cobalt or the nickel.

Pound the ore and dry it with charcoal till no more arsenic is disengaged. On the dried ore pour two-thirds of concentrated sulphuric acid, weakened with twice the quantity

quantity of water. To this mixture add nitre till red vapours cease to be disengaged. Dry it, and increase the fire till the red vapours, which again make their appearance, have ceased: in this operation the small quantity of sulphur which remained from the first drying is consumed. Levigate the mass while hot with water; mix the clarified leys (which are of different colours, according to their principles) with a solution of common potash, till they cease to effervesce. If the clear liquor indicates copper by turning red a piece of polished iron, decompose it entirely with potash; wash the precipitate, dry it, and expose it to the fire with a proportionable quantity of muriate of ammoniac in earthen vessels. If the cobalt does not contain too much copper, it is almost always separated by the quantity of muriate of ammoniac already mixed with it; otherwise, it is necessary to recommence the operation with the residuum, and continue till the last portion of muriate of ammoniac which is sublimated, and the residuum which is dissolved in water, exhibit no traces of copper. When this solution is freed from all its copper, decompose it with potash; let the precipitate stand for some time in a solution of potash; after which wash it carefully, and put it away without drying.

Saturate a small quantity of this precipitate with sulphuric acid; mix with it a little sulphate of ammoniac, and crystallize the mixture. If the crystals are greenish, it proves that they contain nickel; but if they are not, still you cannot be certain of the contrary; of this you cannot be sure till you obtain crystals of a beautiful red, by four or five crystallizations.

If the precipitate contains nickel, divide it into four nearly equal parts; saturate one of these with sulphuric acid, and observe as accurately as possible how much

 acid

acid would be required to saturate the whole. To ascertain this with precision, decompose a quantity of muriate of ammoniac equal to that of the sulphuric acid necessary for neutralizing the precipitate, by the same quantity of the acid. The muriatic acid thus obtained will in a great measure indemnify the expence of the operation.

Dissolve the residuum (which is sulphate of ammoniac with a great excess of acid) in a sufficient quantity of water, and add the precipitate, which is in the form of pulp, which causes the excess of acid to disappear with effervescence. Then, in order to dissolve entirely the carbonated residuum, add sulphuric acid weakened with water, till there ceases to be effervescence, and let the solution stand for some days to settle. Sometimes a small portion of arseniate of iron is likewise separated. If the quantity of nickel in the cobalt is considerable, it deposits crystals of a dirty green in the gelatinous precipitate. Pour off the clear liquor, evaporate it by a gentle heat to a pellicle, and crystallize it, by leaving it to cool slowly. Evaporate afresh the mother-water, and crystallize it till the crystals are very small and of a beautiful crimson colour. The mother-water which remains is then free from nickel.

Dissolve in boiling water all the crystals, which are of very different colours, and crystallize as before. Repeat the same operation till the crystals and the mother-water are of a light green, and the crystals do not change their colour, by reiterated crystallizations.

The tedious labour of the crystallizations may be greatly abridged, by always selecting the crystals of the same colour; and in this manner you may perform in nine operations, what would otherwise require thirty-two.

The

The author likewise says that this produce of nickel is a triple salt of neutral sulphate of ammoniac and neutral sulphate of nickel, and that it is the less soluble in water, the more it approaches to absolute purity. The elevation of temperature greatly contributes to the solubility of this salt; it is imperfectly decomposed by carbonate of potash; carbonate of nickel is precipitated, and the sulphate of potash is left with sulphate of ammoniac in the liquor, which, even in evaporation, retains a greenish tint. If a small excess of potash be added, the ammoniac which is set at liberty dissolves a portion of the oxyd of nickel, and forms with it a blue liquor.

The triple salt of cobalt is much more soluble than that of nickel; and the more pure, the more soluble it is: its crystals always grow smaller and redder. This salt is likewise almost always composed of neutral sulphate of ammoniac; but it must be observed that it retains some nickel, but scarcely any ammoniac, if too small a quantity of sulphate of ammoniac be used for the separation. With a small excess of that salt, it forms with the sulphate of cobalt a combination that is imperfectly decomposed by the carbonate of potash, and whose precipitate is redissolved by an excess of potash. Hence it appears that the sulphate of ammoniac is more disposed to form a triple salt with the sulphate of nickel, than with the sulphate of cobalt.

Process for preparing pure Gallic Acid. By M. RICHTER.

From the ANNALES DE CHIMIE.

STEEP a pound and a half of galls reduced to a fine powder in cold water, taking care to agitate the mixture frequently. Press the whole through a cloth; mix the pulp with fresh water, and submit it to the press. Put the liquors together and evaporate them with a very gentle heat, and you will obtain a matter of a dark brown colour and very brittle. This matter reduced to a very fine powder and steeped in pure alcohol gives a pale straw colour. The second infusion has scarcely any colour; it leaves a brown residuum, which is almost entirely pure tannin. Mix the two alcoholic liquids, and distil them in a small retort to one eighth. The liquor forms almost a solid mass; pour water upon it, and heat it gently: you will then have a clear and almost colourless solution.

By submitting this solution to evaporation, you will obtain from it very small and white prismatic crystals; the liquor furnishes more, but they are commonly a little coloured; it is sufficient to levigate them with water to obtain them very white. By this process half an ounce of crystals is procured from one pound of galls; these crystals are extremely light, and consequently occupy a considerable space. They possess the following properties.

1. They are less soluble in water than in alcohol; the aqueous solution reddens the tincture of turnsol; they combine with alkaline carbonate, and disengage from them carbonic acid.

2. Black precipitates are formed in solutions of iron by alkaline gallates; all other metallic solutions are like-

wise

wise decomposed by these combinations; but, if a solution of pure gallic acid be added to a neutral and perfectly clear solution of iron, no change of colour takes place till the solution of iron is decomposed by the external air, which by oxydating the iron still more, and forming a sulphate of iron of a different nature, is not favourable to the combination of the gallic acid with the oxyd of iron in excess, and produces a black colour. If to a solution of iron you add oxyd of iron recently precipitated, you immediately obtain a black precipitate: the same result is obtained by bringing oxyd of iron in contact with a solution of pure gallic acid.

Iron, treated with a solution of gallic acid soon gives a black solution, but which can scarcely be entirely deprived of its colour by precipitation.

Tannin dissolves in gallic acid and yields a liquor resembling the infusion of galls; this liquor immediately precipitates iron black, by a double affinity, the tannin combining with the acid and disengaging oxyd of iron, which unites with the gallic acid.

From all these experiments it results:

1. That gallic acid does not separate iron from sulphuric and some other acids, excepting some change of combination takes place in the solutions; in this case, the iron, becoming more oxydated, requires a much greater quantity of acid, and the oxyd of iron unites with the gallic acid.

2. That when a solution of gallic acid immediately forms a black precipitate in neutral solutions of iron, it is not pure, and commonly contains tannin, which combines with the sulphuric acid, and separates from it the oxyd of iron which is dissolved by the gallic acid.

3. That

3. That during the preparation of gallic acid all contact with iron must be avoided even in the filtering paper, which is rarely exempt from it, otherwise the acid is discoloured by the iron. It may easily be discovered that acid contains iron, when, in evaporation, you observe that small violet spots are formed in the places where the acid is about to crystallize.

4. That, as gallic acid is very soluble in alkohol, and tannin scarcely at all, this re-agent may be employed to separate them; but the alkohol should be used very strong; for if it contains ever so little water, it will dissolve some tannin.

5. Of all the processes recommended for the preparation of gallic acid, this furnishes it in the greatest abundance and of the best quality. For if we consider in particular that recommended some years ago, which consisted in employing the solution of muriate of tin, afterwards sulphurated hydrogen of gas, and lastly alkohol, we may easily imagine, particularly if we have practised it, how defective, expensive, and disadvantageous it must be; and at last it amounts to nothing more than rendering tannin insoluble in alkohol; and nothing is effected excepting that this re-agent dissolves gallic acid alone. As to the process which recommends the use of glue, that is quite as bad: you indeed succeed in separating the greatest part of the tannin, but a considerable portion nevertheless remains in solution, and even appears that the liquor which is obtained after the separation of the precipitate formed by the glue, is nothing but a combination of glue, tannin, and gallic acid, from which not an atom of gallic acid in pure crystals can be procured.

Intelligence relating to Arts, Manufactures, &c.

(Authentic Communications for this Department of our Work will be thankfully received.)

Method of preserving Hops for making Beer.

DISTIL a quantity of hops with water; when you have drawn off the distilled water, separate from it the essential oil which floats at the top; press the hops which remain in the still, boil them a second time, and evaporate to the consistence of extract, adding to them the distilled water. When you are going to use them, pound the essential oil with a small quantity of sugar, and dissolve it together with the extract in the wort. It makes the beer more bitter than usual, whence it is concluded that by employing the ordinary quantity of hops you obtain a beer that will keep longer, or might save a certain portion of that quantity. The author of the above discovery likewise proposes, in years when hops are scarce, to substitute for it the *menyanthes trifoliata*, taking the precaution to add one-fourth or one-third of good hops.

New Metal denominated Niccolan.

Dr. Richter, of Berlin, has discovered a new metal, which is subject to magnetic attraction. As it generally accompanies nickel, it is very similar to it in appearance, on which account it has probably been hitherto confounded with that substance, he has given it the denomination of *Niccolan*.

List

List of Patents for Inventions, &c.

(Continued from Vol. VI. Page 456.)

RICHARD JUBB, of Bridge-row, in the parish of St. George, Hanover-square, in the county of Middlesex, Whitesmith; for improvements in making and tuning the musical instrument called the Pedal Harp; by which the half-quarter note is produced thereon with peculiar sweetness and harmony; and the farther addition of an harmonic stop made thereto; and also certain improvements in tuning the violin and other stringed instruments. Dated April 5, 1805.

BARNOFALL ROBERT DODD, of Change-alley, in the city of London, Civil Engineer; for various improvements in the construction of fire-places, and adapting stoves and grates thereto. Dated April 18, 1805.

JOSEPH BRAMAH, of Pimlico, in the county of Middlesex, Engineer; for sundry improvements in the art of making paper. Dated April 25, 1805.

THOMAS ROWNTREE, of the parish of Christ Church, in the county of Surrey, Engine-maker; for an axletree and box for carriages on an improved plan. Dated April 25, 1805.

CHARLES HOBSON, of Sheffield, in the county of York, Plater, and CHARLES SILVESTER, of the same place, Chemist; for a method of manufacturing the metal called zinc into wire, and into vessels and utensils for culinary and other purposes. Dated April 29, 1805.

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

No. XXXVIII. SECOND SERIES. July 1805.

Specification of the Patent granted to JONATHAN HORNBLOWER, *of the Borough of Penryn, in the County of Cornwall, Engineer; for a new-invented Steam Wheel or Engine, for raising Water, and for various other useful Purposes in Arts and Manufactures.*

Dated March 26, 1805.

With a Plate.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said Jonathan Hornblower do declare, that the following is a description of my said invention, both in respect to its principles and also the way and manner in which the same is to be performed, and rendered practically useful; that is to say

First. In respect to principles, I cause the steam to pass from boilers, of any ordinary construction, into steam-vessels, so particularly contrived and disposed as to produce an immediate circular motion round an axis, and thereby communicate a rotary motion also to other parts that may be appended to, or connected with, the ma-

machines, without the intervention of wheel-work, and other complicated machinery, which has hitherto been found necessary, where motions that are rotative are produced by means of such as are rectilinear and interchangeable.

Secondly. I cause the steam to operate on certain moveable parts, so connected with an axle within the aforesaid vessel that they occasionally, and alternately, present unequal areas to the action of the steam; by which means the counterbalance or equipoise, which would otherwise exist on opposite sides of the axis, is done away.

Thirdly. The moveable parts which compose the said unequal areas do successively form a partition, thereby constituting two several apartments in the said steam vessels, so that in the act of their interchanges a continuous circular motion is produced without suffering any communication to exist between the aforesaid two apartments.

Fourthly. The steam vessel is so constructed as for one of its apartments to receive a constant supply of steam from the boiler, whilst the other apartment communicates uninterruptedly with the condensing apparatus.

Lastly. From the practical application of the aforesaid principles (as hereinafter more particularly set forth), I obviate all those inconveniences attendant on such steam-engines as are retarded in their operations from *vis inertiæ* as often as the direction of their motions are reversed, or such as require fly-wheels, of a magnitude so enormous as to occasion a vast absorption of power. And in order for the better comprehension and understanding how the aforesaid principles may be reduced to practical use, I do hereby farther declare, that although I vary my modes of construction, as a difference in circumstances

cumstances may offer, to produce the same effect, and obtain the main purpose intended: yet I principally adhere to the following method, as being fully answerable to what is required, and as best calculated to be understood from a description of the same, that is to say:

First. The vessel in which the steam operates is made of cast-iron, extremely resembling a globe, flattened at its poles, see Fig. 1, (Plate IV.) which shews one of its sides, the other being similar to it. Fig. 3 is a representation of the parts of the machine which move round within the steam-vessel as already generally expressed, and these I call vanes. And Fig. 2 represents the interior of Fig. 1, with its lid removed. The pipe A, at Fig. 1, receives the steam from the boiler, to which is connected a valve-box, of any usual construction, by which to regulate the admission of steam. At B the eduction pipe is connected, leading from the upper apartment to the condensing apparatus, and turning in such a direction as may be most convenient for the discharging-pump to be wrought by means of an arbor, turned by the axle of the machine; on which arbor is a small fly-wheel, for the purpose of regulating the inequality of the crank to which the pump-rod is attached. C C is a square plate of metal, cast with the lower part of the steam vessel; by which means the whole is fastened down at the corners to the flooring of the house with iron bolts. D D is a middle part of the steam vessel, furnished with flanches, for the purpose of screwing it to E E, and also for receiving the lid F; by which means the partition within is secured to its place in the middle of the machine, and the lid may easily be removed for the purpose of rectifying and repairing the internal structure. G is the square part of one end of the axis of the machine, over which is placed a gland H, divided into parts, in

order that it may be put on over the square, and properly embrace the round part of the axis. Within this gland is a stuffing-box, for the purpose of keeping the axle both air and steam tight. In one side of the lower apartment of the steam vessel is a small opening (secured by a lid), for the purpose of cleaning that part of the machine.

Fig. 2 represents the partition within the steam vessel, which may be made either of brass or iron, or of both those metals combined. B B is the lower flanch, the upper parts being taken away. C C are the two openings or passages for the vanes: these I call vane-ports; and, to obtain a proper idea of their figure, it must be observed, that the largest vane-port is formed by the exterior portions of two cones *z z*, and at *y y*, by a portion of the concave part of a sphere. The extent of this passage throughout must at least be equal to ninety degrees of a circle, and the vanes of a sufficient width, so that two of them may always make their entrance into the vane-ports before the other two make their exit. The edge *c c* may therefore be supposed to descend into the lower apartment one half of their depth, and to rise the other half to meet the eye; but it is not necessary that *z z* be so deep all the way as *y y*, but converge towards the centre of the machine. This is the ascending vane-port; the descending one is included between D D, which are rabbets or seatings for receiving a packing, hereinafter farther described; and *x x* represents a rising edge, so as to obtain a depth at least equal to the thickness of the vanes; one half of which edging is below and the other half above the main axis. These edges receive two metal plates, fixed down with screws on them, for the purpose of confining the packing. The part E is also formed spherically, and is provided with a packing-groove,

groove, which meets the edge of metal in the middle of the vanes *k k*, Fig. 3. F F, is the main axle of the machine, laid in its place without the vanes; one end of which is to perform the necessary work required, and the other is applied to the discharging-pump. At D D the packing extends to W W, so as to embrace the nave as well as the descending vane, by which means both the nave and the vanes move steam-tight in their revolutions. *v v v v* is that part of the partition which forms a plane at the axis of the globe, and is secured in its place by being seated in a rabbet with the usual jointing materials on the interior margin of the steam vessel. G G are two brasses let down into the partition, and they are raised or depressed with screws, as adjustment may require. At *t t* spaces are left for packing round the axle; and the upper brasses which keep down the axle serve also to keep it in its place. At H H are the stuffing-boxes, mentioned in Fig. 1; they have a division-plate of metal in them, so that S S being supplied with steam from the valve-box, the packing of each side of these vacuities are rendered air-tight. The manner in which the partition and vane-ports are constructed, is by rivetting the two parts *vvvv* together by means of flanches at I I, first having mounted them on an axis, to correct, by turning, (either by hand or otherwise,) the want of smoothness and truth from the casting; and when this is done the main axle is fixed to its place as a guide by which to set up the four vanes, as at Fig. 3, where, by a mere inspection, it is plain how this is performed. The open vane exhibits a frame of metal, which receives a plate on each side: these plates, with the edge of metal K K, cast with the frame, form grooves and vacuities to receive the packing. The nave being hollow, receives two iron axles,

axles, which are curved in the middle, and there cross each other. The manner in which they receive the vanes is shewn by the figure; also how the packing renders them steam-tight on the spherical part of the nave, and that when one of them is moved its opposite vane on the same axle must likewise be moved. The main axle is turned true by rivetting the two parts together at the nave, and re-rivetting them after the cross axles are set in their places. All the several parts of the machine being then put in their respective situations, it is very evident that when steam is admitted into the lower apartment the rising vane, which occupies the largest passage, must overpower the other in its descent; and that if by any means one of the vanes be turned a quarter of a revolution, it must at the same time carry with it the one which is connected on the opposite side of the nave; and this turning is effected by fixing with screws a block of wood on the partition at K K, in the form of a strong bracket. This block will not permit the ascending vane to pass it without being turned on its edge, by which means the one below is turned at the same time, to present its broad surface to the large vane port. It may be necessary to remark, that when the machine is to be set at work, the steam is not admitted into the upper apartment of the vessel, to exclude the air, but enters immediately from the valve-box to the eduction or discharging pipe, in order to preserve the grease which is made use of to lubricate the internal moveable mechanism of the engine.

For the farther explanation of the manner in which I prepare the packing for the necessary parts of the machine, I farther remark, that I arrange strands of rope-yarn by a method somewhat similar to that adopted in making fringe. A sufficient number of fringes are laid at

B

Fig. 5.

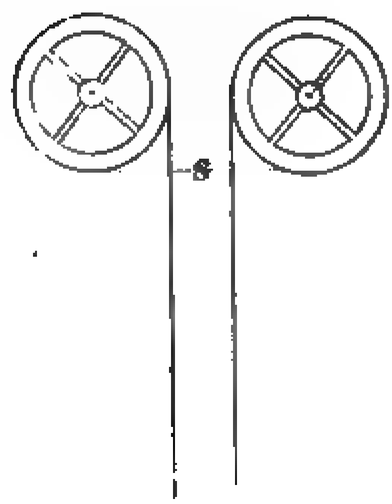


Fig. 2.

Fig. 4.

Fig. 3.

at the side of each other for filling the grooves or spaces they are to occupy; and then they are sewed slightly together. After this they are, for the vanes, placed edgewise on a flat iron collar, jointed at its corners, and then lashed firmly thereto by means of rope-yarn passing through the body of this fringed fabric, and wrapping round the iron collar, so that when the collars of hemp and iron are in their respective places, the end of the fibre of the hemp is presented to the abrading parts; and by means of a small pin, driven through the thickness of the vane at S S, Fig. 3, the whole are immoveably retained in their proper situations. I also adopt the same kind of fabric for the side packing at D D, Fig. 2, but I here fasten the hempen fringes to pieces of wood instead of iron, and present the ends of their fibre to the sides of the descending vane. At other places where this kind of packing is not eligible, nor so much required, I adopt the common method of packing. As it is not eligible any more than absolutely necessary, to pack the vanes whilst they are situated in the large vane port, they are by cutting or shearing successively made to enter it, and receive their proper configuration. Where circumstances will admit, I adopt the use of angular teeth, in the form of a cheveron, for the purpose of connecting and turning any wheel-work that may be an appendage to the machine, by which means I obtain all the advantages resulting from small teeth, in respect to what artists call their taking and leaving, without the liability of their being so soon broken, or otherwise affected, from the diminutiveness of their size.

Fig. 4 shews an eligible proportion for such angular teeth, their depth being equal to the part of the tooth at S in the direction of the dotted line. In order to make my machine appropriate to the draining of mines, &c. I adopt

adopt the use of rope or ropes, with buckets so appended to them that the rope being endless, and made to revolve by the engine, a number of the said buckets are caused to descend on one side whilst others are ascending on the contrary side of the shaft.

Fig. 5 shews two wheels or pullies over which the rope passes, and over one of which the buckets may be emptied of their contents of water or other materials. These wheels are turned by the engine at one and the same time, by wheel and pinion, or otherwise; and their axles are so disposed as to cause them to stand oblique to the horizon, and also to one another, in order that the ascending buckets may not interfere with the rope at S.

In witness whereof, &c.

Specification of the Patent granted to WILLIAM EVERHARD BARON VAN DOORNIK, *of Well-street, in the County of Middlesex; for certain Compositions, formed by uniting an absorbent or detergent Earth, with other Ingredients, so as to render the same more effectual in washing or scouring, and for various other Purposes to which Soaps or detergent Earths are now applied.*

Dated December 19, 1804.

TO all to whom these presents shall come, &c. Now KNOW YE, that I the said William Everhard Baron van Doornik, in compliance with the said proviso, do hereby describe and ascertain the nature of my said invention, and in what manner the same is to be performed, *viz.* Procure a sufficient quantity of marl or saponaceous earth, which must be taken as clear as possible out of the ground, and put into a kiln to dry; and when it is perfectly dry reduce it to a fine powder, by grinding, sifting,

sifting, or otherwise; and then, if thought needful, expose the same to the air, either made into cakes or otherwise, in order that its colour may be improved, and its other qualities, more or less, altered. To make a ton, or twenty hundred weight, of the patent composition or soap for general use, take six hundred and ninety pounds weight more or less of tallow, or other fat or oil, and proceed, by the ordinary process, to convert it into soap. But when the tallow, fat, or oil, is nearly converted into soap, put into another boiler four hundred and ten pounds weight, or thereabouts, of the marl or saponaceous earth, pulverized, sifted, and bleached, by exposure to the air, if such bleaching should be thought necessary, as before mentioned, with an equal quantity of strong lees, or solution of caustic alkali, stirring it constantly; and, after boiling it three, four, or five hours, as may be found necessary, pour it, when hot, and in a gluey state, into the boiler of soap, prepared with tallow, fat, or oil, as aforesaid, being also hot, and bring the whole again into a gluey or liquid state, by pouring into it about two hundred and ninety pounds weight of the lees, or such quantity as may be thought sufficient. Then keep it turning and boiling gently for about an hour; when it is to be poured into the frames; when it is left to cool till the next day, and then cut it up with brass wires, in the same manner as is done in the process of making soap.

To make a ton, or twenty hundred weight of the patent composition or soap, for the use of the navy, in washing by sea-water, take four hundred and thirty pounds weight, more or less, of tallow, or other fat or oil, and proceed to convert it into soap by the ordinary process. And when the tallow, fat, or oil, is nearly converted into soap, put into another boiler six hundred and

thirty pounds weight, more or less, of the marl or saponaceous earth sifted, pulverized, and, if needful, bleached, as above mentioned, with an equal quantity of lees, stirring it constantly; and after boiling it three, four, or five hours, as may be found necessary, pour it, when hot, and in a gluey state, into the boiler of soap, prepared with tallow, fat, or oil, as aforesaid, also hot, and bring the same again into a gluey or liquid state by pouring it into about two hundred and ninety pounds weight of lees, or such other quantity as may be thought sufficient. Then keep it turning and boiling gently for about an hour, when it is to be poured into the frames, where it is left to cool till the next day, and then cut it up with brass wires, in the same manner as is done in the process of making soap.

In witness whereof, &c.

Specification of the Patent granted to WILLIAM HAWKS *the Younger, of Gateshead, in the County of Durham, Iron-Manufacturer; for sundry Improvements in constructing and making Chains for the Use of Mines and other Purposes.* Dated July 2, 1805.

With a Plate.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said William Hawks do hereby describe and ascertain the nature of my said invention, and the manner in which the same is to be performed as follows; that is to say:

In Table 1, (Plate V.) C represents a bar of iron, steel, copper, or other metallic substance, out of which a link is to be cut or formed to make part of the chain; E is a coffin or box, the area of which the steel plates B and

and D are made exactly to fit; and the holes F F through these plates are to be of equal circumference, and must be exactly opposite to each other when placed in the coffin.

The bar C being placed in the coffin between the steel plates B and D, the steel punches A A are to be placed in the holes F F in the upper plate, and are to be forced through the bar C by a powerful screw, or any other mechanical power; C 2 represents the bar thus perforated, and this process being repeated upon other bars similar to the bar C, will produce the nicest accuracy and a perfect similarity, both with respect to the size of the holes and their distance from each other in each bar so perforated.

In Table 2, Fig. 1 represents the bar C perforated in the manner before-mentioned, placed between two steel dies G G, which have holes through them, corresponding with the holes in the bar C; and the bar C so placed, is confined there by means of two steel pins which pass through the two dies, and the bar C, as represented in the figure, and which pins are there fastened by keys going through them as represented at H H, or by screws and nuts.

Fig. 2 is another die of steel or iron with a surface of steel, through which there is a mortice I I, of such dimensions, and so corresponding in figure with the dies G G, that they may just pass freely through, the bar C 2, confined between the dies G G as before-mentioned, is laid on the die Fig. 2. the under die G being at the same time received into the mortice I I, and a screw or other mechanical power being applied upon the upper die G, the bar C 2 is cut by the edges of the said upper die G, and of the mortice I I, into the figure of the link represented at C 3. The die, Fig. 2, may be made in the

 form

form represented, or in any other form calculated to produce a shearlike or slanting cut with the edges of the said upper die G, by which the resistance of the bar to be cut will be much less than if the surface of Fig. 2 were flat or in a strait line.

In Table 3, C 3, is another representation of the link formed as before-mentioned; L represents a transverse section or end view of a bar of iron or other metal brought into that form, by being made to pass between rollers cut for that purpose. The bar L thus rolled, is then cut into proper lengths and formed into bushes or thimbles, as represented at M M; the smaller ends of these bushes or thimbles being of a size, corresponding with and fitting the holes perforated in the link C 3, are made to pass through the holes in the link, till the projecting part or shoulder of the bush or thimble comes in contact with the link, as represented at N N. O O are two dies which have holes through them, corresponding with the holes in the link C 3. After the bushes have been inserted at N N, in the face of these dies O O, countersinks are made at Q Q Q Q, of the same figure and dimensions as the thicker ends of the bushes M M. The link C 3 (having two bushes or thimbles in it, as represented at N N) being laid on the under die O, with the thicker end of each bush or thimble placed in the countersink of the die, and a steel pin being passed through each bush as at R R, the upper die is laid upon it; and the force of a screw or any other mechanical power being applied, the dies O O are pressed towards each other; and when the bottom of the countersink in the upper die O comes in contact with the end of the bush or thimble which has passed through the link, the bush or thimble is pressed down, and necessarily takes the form of the countersink in the die O, care having been previously taken to ascertain

Table 1.

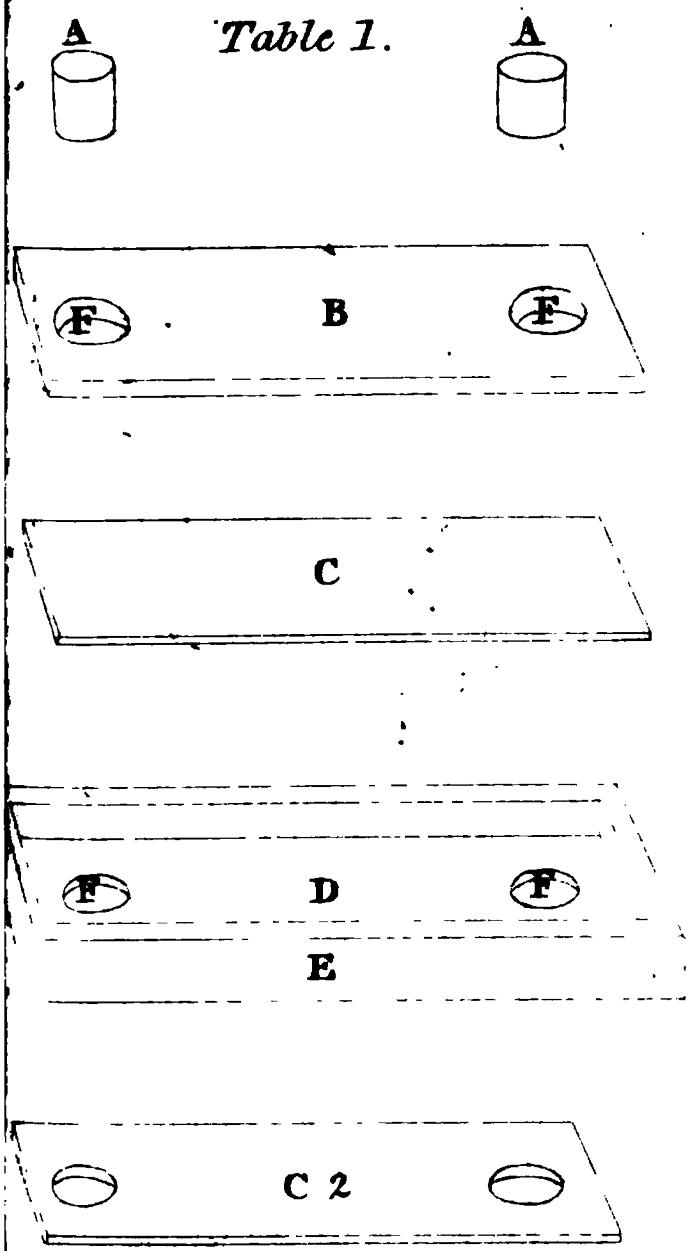


Table 2.

Fig. 1.

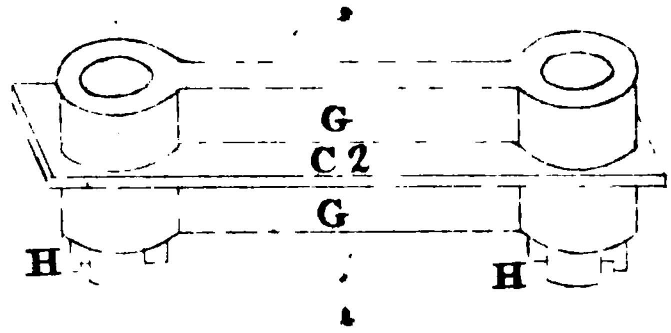


Fig. 2.

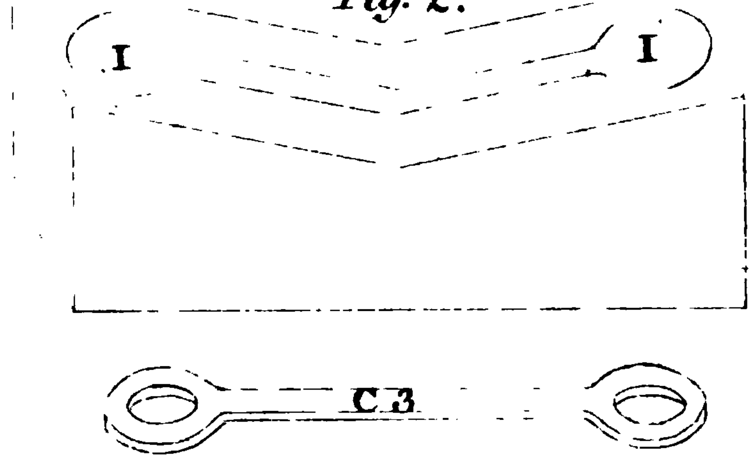


Table 3.

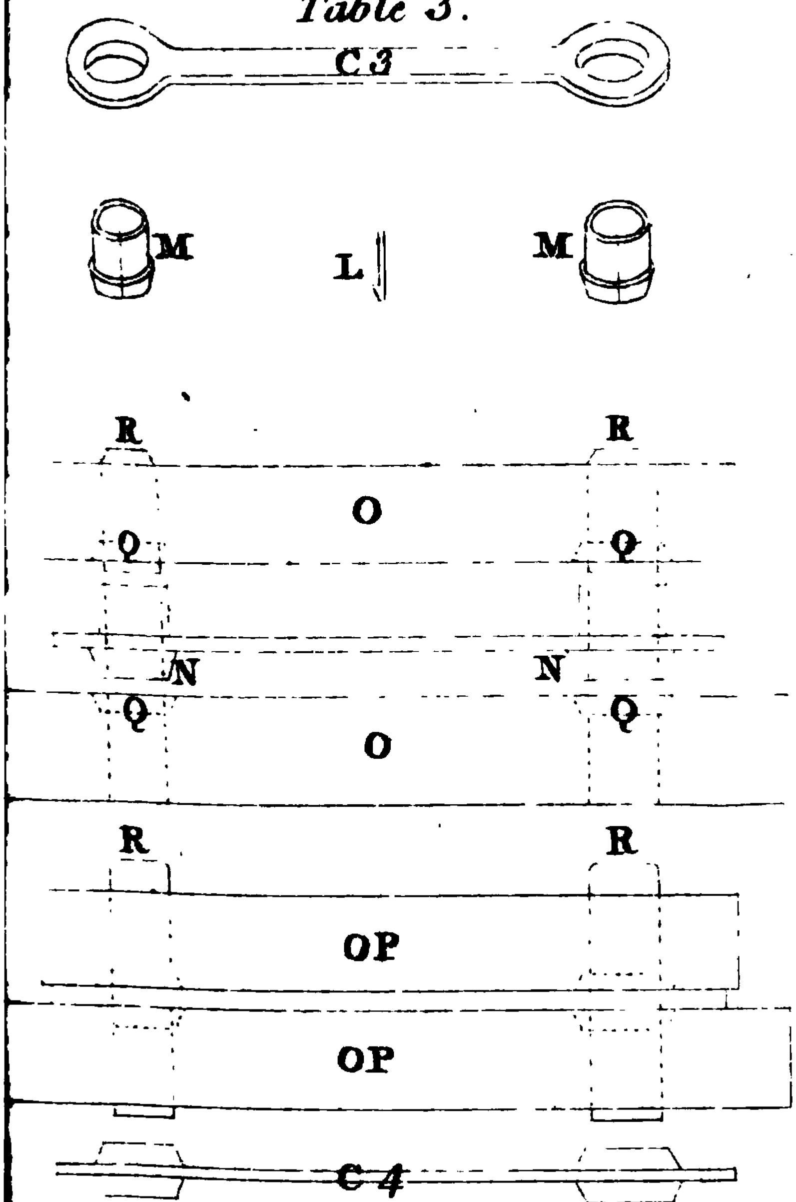
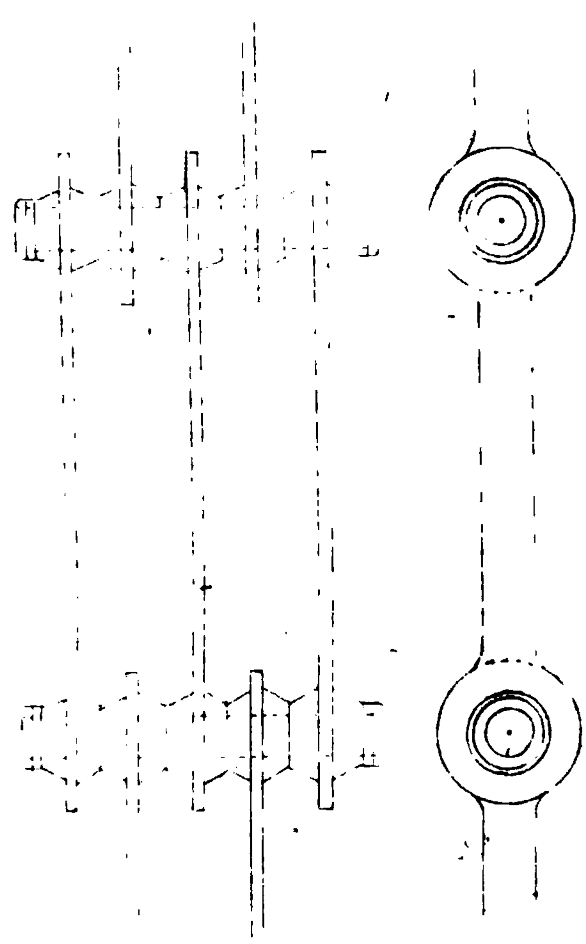


Table 4.



certain that the quantity of metal in the bush or thimble, which has been passed through the link, shall neither exceed nor be deficient of the quantity required to fill the countersink completely when thus pressed. Q P Q P represent the two dies with the link between them, at the end of this operation the dotted lines being intended to represent the figure of the bushes or thimbles, and the countersinks with the steel pins through them; these steel pins are of the same size as the pins which are afterwards to connect the links together when forming the endless chain. C 4 represents the link when bushed or thimbled in the manner described, and it is evident that the nicest accuracy must be produced with respect to the length of the bush or thimble thus fixed in the link, the size of the hole in the bush and the distance of the holes from each other. Of course every link in the chain must duly bear an equal share of the weight to be sustained.

I desire it may be observed, by way of general explanation or specification of my said invention, that such invention consists in producing a link or links with its bushing, as represented at C 4, with those properties above described of being all exactly alike, both with respect to the distance and size of the holes, and also the shape of the link.

Table 4 represents a front and profile view of a piece of the chain put together, where the links are placed alternately three and two abreast, but this may be varied as circumstances required, viz. one link or two, three or four, &c. abreast, at the discretion of those who are to use the chain.

In witness whereof, &c.

Specification

Specification of the Patent granted to JACOB BUFFINGTON, *of the City of Bristol, Gentleman; for a new Method of straining or stretching (technically called habiting) all Kinds of Woollen Cloth for cropping or shearing, and for stretching or straining all other Kinds of Piece Goods.*

Dated October 30, 1804.

With an Engraving.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Jacob Buffington do hereby declare, that my said invention is described in manner following; that is to say: To strain cloth, or any other stuffs that require to be strained, I secure the lists of the cloth to one edge of strong web by lacing or otherwise; the other edge of the web is made fast to a small rope or cord that passes through appertures in frames, so made as to suffer the web to pass freely when moved forwards, and to prevent the rope or cord from drawing out in the act of straining.

In the margin of these presents is represented a frame, which answers this purpose; but the construction may be varied, if thought necessary, so that the principle object of the invention is adhered to, *viz.* to strain the cloth or stuffs from selvage to selvage, or list to list. By this means the operation of cropping, shearing, &c. is much facilitated, and the workman enabled to produce better work, and in less time than he could by any former method.

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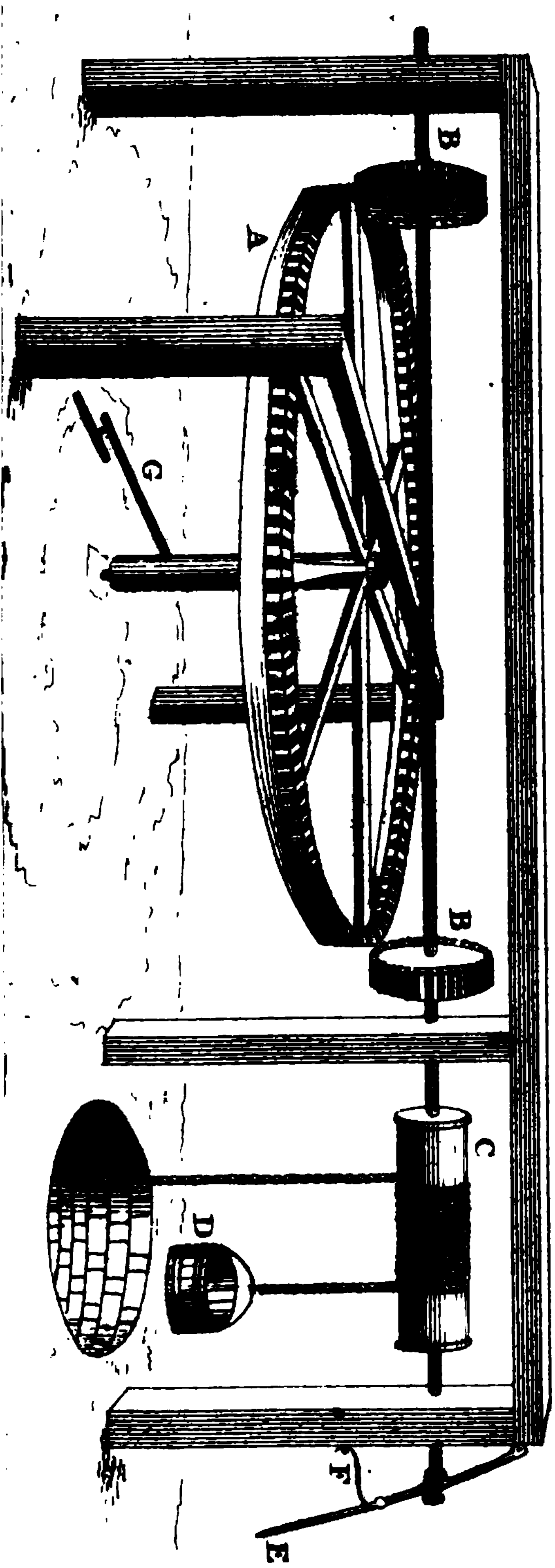

Fig. 3.

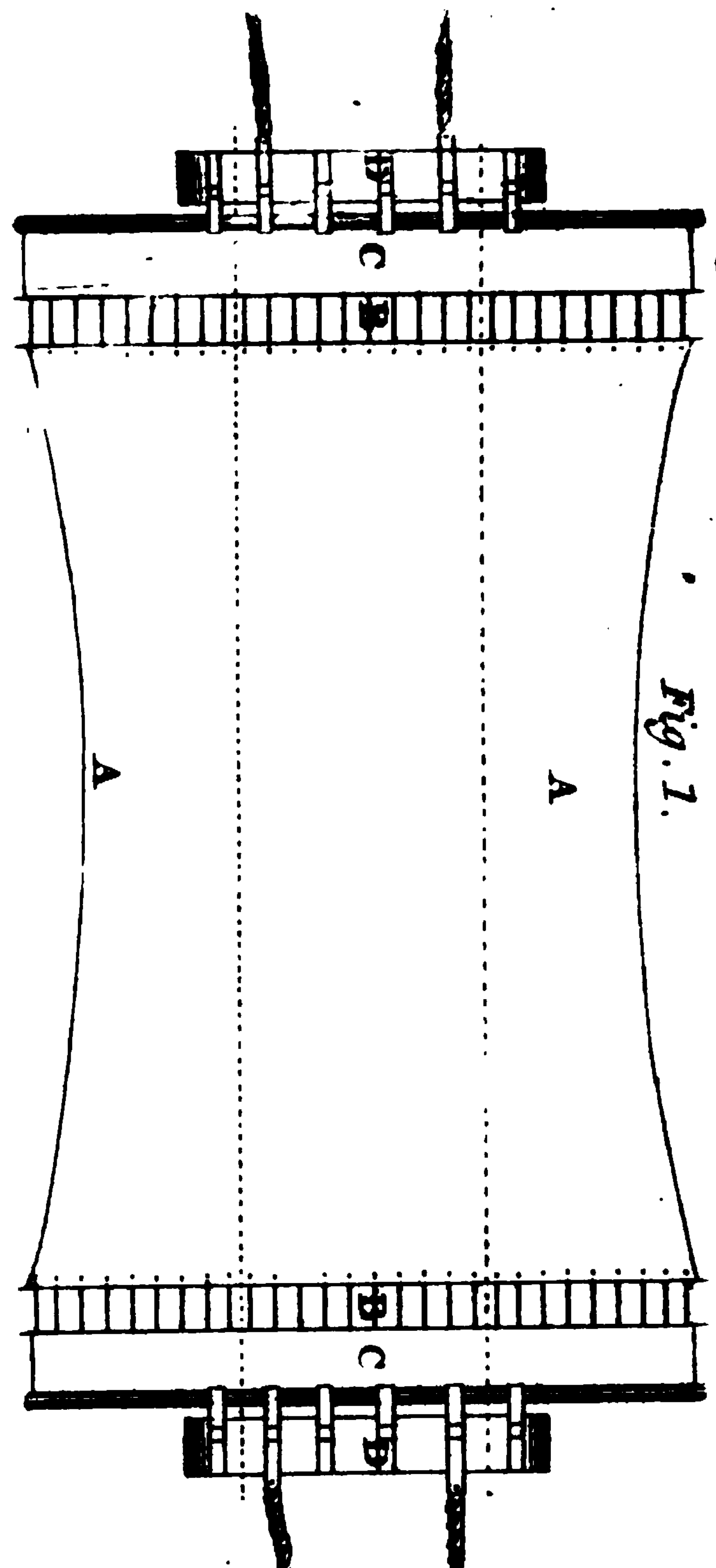

Fig. 1.

Fig. 2.

Description of the Drawings.

(See Plate VI.)

Fig. 1, A A, represents the cloth passing over the shearing-board, which is shewn underneath by the dotted lines, and on which the habit-frames are placed according to the width of the cloth.

B B exhibits the hooks or lacing, or any other means that may be found convenient to fasten the cloth to be sheared to the webs C C, which should be made of any cloth or webbing of little or no elasticity; which webbing is attached to the selvage or list of the cloth the whole length, or less than the whole length if thought more convenient, previous to its introduction into the frame. On the other side of this webbing is attached a small rope or cord, either covered with leather or part of the webbing, or any other suitable material, so as to make it pass freely through the habiting frames D D; which frames are made of iron, or any other proper material.

These frames are extended from, or drawn nearer to, each other, as occasion may require, by means of lines, cords, chains, or rods, as shewn at C C, which are connected to a lever, windlass, pullies, rack and pinion, or any other power that may be found convenient for tightening or slackening the cloth at pleasure.

Fig. 2 is a section of one of the gripes of the habiting frames D, Fig. 1, through which the rope or cord attached to the webbing passes.

In witness whereof, &c.

Essay

Essay on the Cohesion of Fluids.
By THOMAS YOUNG, M. D. For. Sec. R. S.

(Concluded from Page 31.)

V. Of apparent Attractions and Repulsions.

THE apparent attraction of two floating bodies, round both of which the fluid is raised by cohesive attraction, is produced by the excess of the atmospheric pressure on the remote sides of the solids above its pressure on their neighbouring sides; or, if the experiments are performed in a vacuum, by the equivalent hydrostatic pressure or suction derived from the weight and immediate cohesion of the intervening fluid. This force varies ultimately in the inverse ratio of the square of the distance; for, if two plates approach each other, the height of the fluid that rises between them is increased in the simple inverse ratio of the distance: and the mean action, or negative pressure, of the fluid on each particle of the surface is also increased in the same ratio. When the floating bodies are both surrounded by a depression, the same law prevails, and its demonstration is still more simple and obvious. The repulsion of a wet and a dry body does not appear to follow the same proportion: for it by no means approaches to infinity upon the supposition of perfect contact; its maximum is measured by half the sum of the elevation and depression on the remote sides of the substances, and as the distance increases, this maximum is only diminished by a quantity, which is initially as the square of the distance. The figures of the solids concerned modify also sometimes the law of attraction, so that, for bodies surrounded by a depression, there is sometimes a maximum, beyond which the force again

again diminishes: and it is hence that a light body floating on mercury, in a vessel little larger than itself, is held in a stable equilibrium without touching the sides. The reason of this will become apparent, when we examine the direction of the surface necessarily assumed by the mercury in order to preserve the appropriate angle of contact, the tension acting with less force when the surface attaches itself to the angular termination of the float in a direction less horizontal.

The apparent attraction produced between solids by the interposition of a fluid does not depend on their being partially immersed in it; on the contrary, its effects are still more powerfully exhibited in other situations: and, when the cohesion between two solids is increased and extended by the intervention of a drop of water or of oil, the superficial cohesion of these fluids is fully sufficient to explain the additional effect. When wholly immersed in water, the cohesion between two pieces of glass is little or not at all greater than when dry: but if a small portion only of a fluid be interposed, the curved surface, that it exposes to the air, will evidently be capable of resisting as great a force as it would support from the pressure of the column of fluid that it is capable of sustaining in a vertical situation; and in order to apply this force, we must employ in the separation of the plates, as great a force as is equivalent to the pressure of a column appropriate to their distance. Morveau found that two discs of glass, 3 inches French in diameter, at the distance of one-tenth of a line, appeared to cohere with a force of 47.9 grains, which is equivalent to the pressure of a column 23 lines in height: hence the product of the height and the distance of the plates is 2.3 lines, instead of 2.65, which was the result of Monge's experiments on the actual ascent of water. The dif-

ference is much smaller than the difference of the various experiments on the ascent of fluids; and it may easily have arisen from a want of perfect parallelism in the plates; for there is no force tending to preserve this parallelism. The error, in the extreme case of the plates coming into contact at one point, may reduce the apparent cohesion to one half.

The same theory is sufficient to explain the law of the force by which a drop is attracted towards the junction of two plates inclined to each other, and which is found to vary in the inverse ratio of the square of the distance; whence it was inferred by Newton that the primitive force of cohesion varies in the simple inverse ratio of the distance, while other experiments lead us to suppose that cohesive forces in general vary in the direct ratio of the distance. But the difficulty is removed by considering the state of the marginal surface of the drop. If the plates were parallel, the capillary action would be equal on both sides of the drop: but when they are inclined, the curvature of the surface at the thinnest part requires a force proportionate to the appropriate height to counteract it; and this force is greater than that which acts on the opposite side. But if the two plates are inclined to the horizon, the deficiency may be made up by the hydrostatic weight of the drop itself; and the same inclination will serve for a larger or a smaller drop at the same place. Now when the drop approaches to the line of contact, the difference of the appropriate heights for a small drop of a given diameter will increase as the square of the distance decreases; for the fluxion of the reciprocal of any quantity varies inversely as the square of that quantity: and, in order to preserve the equilibrium, the sine of the angle of elevation of the two plates must be nearly in the inverse ratio of the square of the

distance

distance of the drop from the line of contact, as it actually appears to have been in Hauksbee's experiments.

VI. *Physical Foundation of the Law of superficial Cohesion.*

We have now examined the principal phenomena which are reducible to the simple theory of the action of the superficial particles of a fluid. We are next to investigate the natural foundations upon which that theory appears ultimately to rest. We may suppose the particles of liquids, and probably those of solids also, to possess that power of repulsion, which has been demonstratively shown by Newton to exist in aeriform fluids, and which varies in the simple inverse ratio of the distance of the particles from each other. In airs and vapours this force appears to act uncontrolled; but in liquids, it is overcome by cohesive force, while the particles still retain a power of moving freely in all directions; and in solids the same cohesion is accompanied by a stronger or weaker resistance to all lateral motion, which is perfectly independent of the cohesive force, and which must be cautiously distinguished from it. It is simplest to suppose the force of cohesion nearly or perfectly constant in its magnitude, throughout the minute distance to which it extends, and owing its apparent diversity to the contrary action of the repulsive force, which varies with the distance. Now in the internal parts of a liquid these forces hold each other in a perfect equilibrium, the particles being brought so near that the repulsion becomes precisely equal to the cohesive force that urges them together: but whenever there is a curved or angular surface, it may be found by collecting the actions of the different particles, that the cohesion must necessarily prevail over the repulsion, and must urge the superficial

parts inwards with a force proportionate to the curvature, and thus produce the effect of a uniform tension of the surface. For, if we consider the effect of any two particles in a curved line on a third at an equal distance beyond them, we shall find that the result of their equal attractive forces bisects the angle formed by the lines of direction; but that the result of their repulsive forces, one of which is twice as great as the other, divides it in the ratio of one to two, forming with the former result an angle equal to one-sixth of the whole; so that the addition of a third force is necessary in order to retain these two results in equilibrium; and this force must be in a constant ratio to the evanescent angle which is the measure of the curvature, the distance of the particles being constant. The same reasoning may be applied to all the particles which are within the influence of the cohesive force; and the conclusions are equally true if the cohesion is not precisely constant, but varies less rapidly than the repulsion.

VII. *Cohesive Attraction of Solids and Fluids.*

When the attraction of the particles of a fluid for a solid is less than their attraction for each other, there will be an equilibrium of the superficial forces, if the surface of the fluid make with that of the solid a certain angle, the versed sine of which is to the diameter, as the mutual attraction of the fluid and solid particles is to the attraction of the particles of the fluid among each other. For, when the fluid is surrounded by a vacuum or by a gas, the cohesion of its superficial particles acts with full force in producing a pressure; but when it is any where in contact with a solid substance of the same attractive power with itself, the effects of this action must be as much destroyed as if it were an internal portion of the fluid.

fluid. Thus, if we imagined a cube of water to have one of its halves congealed, without any other alteration of its properties, it is evident that its form and the equilibrium of the cohesive forces would remain undisturbed: the tendency of the new angular surface of the fluid water to contract would therefore be completely destroyed by the contact of a solid of equal attractive force. If the solid were of smaller attractive force, the tendency to contract would only be proportionate to the difference of the attractive forces or densities, the effect of as many of the attractive particles of the fluid being neutralised, as are equivalent to a solid of a like density or attractive power. For a similar reason, the tendency of a fluid to contract the sum of the surfaces of itself and a contiguous solid, will be simply as the density of the solid, or as the mutual attractive force of the solid and fluid. And it is indifferent whether we consider the pressure produced by these supposed superficial tensions, or the force acting in the direction of the surfaces to be compared. We may therefore inquire into the conditions of equilibrium of the three forces acting on the angular particles, one in the direction of the surface of the fluid only, a second in that of the common surface of the solid and fluid, and the third in that of the exposed surface of the solid. Now, supposing the angle of the fluid to be obtuse, the whole superficial cohesion of the fluid being represented by the radius, the part which acts in the direction of the surface of the solid will be proportional to the cosine of the inclination; and this force, added to the force of the solid, will be equal to the force of the common surface of the solid and fluid, or to the differences of their forces; consequently, the cosine added to twice the force of the solid, will be equal to the whole force of the fluid, or to the radius: hence the force of the

solid

solid is represented by half the difference between the cosine and the radius, or by half the versed sine; or, if the force of the fluid be represented by the diameter, the whole versed sine will indicate the force of the solid. And the same result follows when the angle of the fluid is acute. Hence we may infer, that if the solid have half the attractive force of the fluid, the surfaces will be perpendicular; and this seems in itself reasonable, since two rectangular edges of the solid are equally near to the angular particles with one of the fluid, and we may expect a fluid to rise and adhere to the surface of every solid more than half as attractive as itself; a conclusion which Clairaut has already inferred, in a different manner, from principles which he has but cursorily investigated, in his treatise on the figure of the earth.

The versed sine varies as the square of the sine of half the angle: the force must therefore be as the square of the height to which the fluid may be elevated in contact with a horizontal surface, or nearly as the square of the number of grains expressing the apparent cohesion. Thus, according to the experiments of Morveau, on the suppositions already premised, we may infer that the mutual attraction of the particles of mercury being unity, that of mercury for gold will be .1 or more, that of silver about .94, of tin .90, of lead .81, of bismuth .72, of zinc .21, of copper .01, of antimony .08, of iron .07, and of cobalt .0004. The attraction of glass for mercury will be about one-sixth of the mutual attraction of the particles of mercury: but when the contact is perfect, it appears to be considerably greater.

Although the whole of this reasoning on the attraction of solids is to be considered rather as an approximation than as a strict demonstration, yet we are amply justified in concluding, that all the phenomena of capillary action

may

may be accurately explained and mathematically demonstrated from the general law of the equable tension of the surface of a fluid, together with the consideration of the angle of contact appropriate to every combination of a fluid with a solid. Some anomalies, noticed by Musschenbroek and others, respecting in particular the effects of tubes of considerable lengths, have not been considered: but there is great reason to suppose that either the want of uniformity in the bore, or some similar inaccuracy, has been the cause of these irregularities, which have by no means been sufficiently confirmed to afford an objection to any theory. The principle, which has been laid down respecting the contractile powers of the common surface of a solid and a fluid, is confirmed by an observation which I have made on the small drops of oil which form themselves on water. There is no doubt but that this cohesion is in some measure independent of the chemical affinities of the substances concerned: tallow when solid has a very evident attraction for the water out of which it is raised; and the same attraction must operate upon an unctuous fluid to cause it to spread on water, the fluidity of the water allowing this powerful agent to exert itself with an unresisted velocity. An oil which has thus been spread is afterwards collected, by some irregularity of attraction, into thin drops, which the slightest agitation again dissipates: their surface forms a very regular curve, which terminates abruptly in a surface perfectly horizontal: now it follows from the laws of hydrostatics, that the lower surface of these drops must constitute a curve, of which the extreme inclination to the horizon is to the inclination of the upper surface as the specific gravity of the oil to the difference between its specific gravity and that of water: consequently since the contractile forces are held in equilibrium by a force

force which is perfectly horizontal, their magnitude must be in the ratio that has already been assigned: and it may be assumed as consonant both to theory and to observation, that the contractile force of the common surface of two substances, is proportional, other things being equal, to the difference of their densities. Hence, in order to explain the experiments of Boyle on the effects of a combination of fluids in capillary tubes, or any other experiments of a similar nature, we have only to apply the law of an equable tension, of which the magnitude is determined by the difference of the attractive powers of the fluids.

I shall reserve some farther illustrations of this subject for a work which I have long been preparing for the press, and which I flatter myself will contain a clear and simple explanation of the most important parts of natural philosophy. I have only thought it right, in the present Paper, to lay before the Royal Society, in the shortest possible compass, the particulars of an original investigation, tending to explain some facts and establish some analogies, which have hitherto been obscure and unintelligible.

Method of banking the Balance of a Time Keeper. By Mr. William Hardy, *of Chapel-street, near White Conduit House.*

With a Plate.

From the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce.

Thirty Guineas were voted by the Society to Mr. Hardy *for this Invention.*

It was at first imagined, that a banking to a watch with a free escapement was quite unnecessary, as the limits

mits of banking were so great as to admit of almost twice 360, or 720 degrees; but, on trial, the balance was frequently found to exceed this quantity, and that a very slight motion given to the time-keeper (particularly when the axis of the balance became the axis of that motion), was sufficient to alter the strength and figure of the pendulum-spring, and position of the pieces in respect of the balance-wheel, so as to change the rate of the time-keeper; and, what was worse, require a new adjustment of the balance, to accommodate itself to the changes made in the spring, and other parts connected with it. Hence it became necessary, that some means should be used to stop the balance at certain limits beyond its natural arch of vibration; and various attempts have been made to effect it. One way is, by a moveable piece on the axis of the balance, which banks against a pin, yet so as to suffer the balance to vibrate more than 360 degrees. Another method is to have a piece moveable on a centre in one of the arms of the balance, and applying itself as a tangent to the pendulum-spring, which passes through a hole in the piece. It has also a knee, which almost touches the plate, and just passes free of a pin placed in it. But when the balance vibrates so as to approach its utmost limits, the action of the spring, while in a state of unwinding, throws the piece outward, so as to fall in the way of the pin, and stop the balance from proceeding farther. Another mode is by a straight spring, screwed upon the plate, having a hook at the end of it, into which a pin placed in the balance strikes, when, as before, the pendulum-spring, in unwinding, touches the straight spring, and moves it a little outwards. There is also a way of banking by means of a bolt, which is thrown back by the pendulum-spring, and made to fall

 in

in the way of a pin placed in the rim of the balance. These are the principal modes of banking now in use, and they do not differ materially from one another in principle. But the weight and friction of so many pieces, on so delicate an organ as that of a pendulum spring, are perhaps nearly as hurtful to the time-keeper as the injury it may sustain when it is left without any banking whatever.

Description of a new and most accurate Mode of banking the Balance of a Time Keeper.

(See Plate VII. Figs. 1 and 2.)

In Figs. 1 and 2 the same letters are placed, to signify the same things. A is the balance to which the pendulum-spring is fastened in the usual way. In one of the crosses of the balance is placed a pin P, which stands a little way above its surface; and when the balance is caused to vibrate a complete circle, the pin in its motion will describe the dotted circle P O Q, and just pass clear of the inside of a projection formed on a cock B, which is fastened on the plate by means of a screw. At about one-fourth of a turn of the pendulum-spring, reckoned from its stud E, is placed a very delicate tapering piece of steel *s*, having a small hole in it, through which the pendulum-spring passes; and it is fastened to it by means of a pin, and stands perpendicular to the curve of the spring. Let the balance be at rest, as represented in Fig. 1, the banking-pin at P, and the banking-piece at *s*. Suppose the balance is made to vibrate from P towards O, when P arrives at the banking-piece *s*, it will pass it without touching, because its extremity *s* lies wholly within the circle traced out by the banking-pin. But when the banking-pin P has arrived at Q, the banking-piece *s* will have advanced at *t*, by the pendulum-spring

Fig. 1.

A

Fig. 2.

spring winding itself up into the figure represented by the dotted curve; and when the banking-pin P (now at Q) returns back to P, and passes on from P towards Q, to approach B, and so complete the other half-arch of its vibration, before P can arrive at the banking-cock B, the pendulum-spring will have unwound itself into the figure described by the dotted curve, and the banking-piece *s* will have advanced into the position at *r*, just touching the banking-cock. Its extremity *r*, however, being thrown beyond the dotted circle, must necessarily fall in the way of the banking-pin, which arrives there almost at the same moment, and is opposed by it, without the slightest shock to the pendulum-spring.

On the Analysis of Soil, as connected with their Improvement. By HUMPHREY DAVY, *Esq. F. R. S.*

With a Plate.

From the COMMUNICATIONS to the BOARD of AGRICULTURE.

I. *Utility of Investigations relating to the Analysis of Soils.*

THE methods of improving lands are immediately connected with the knowledge of the chemical nature of soils, and experiments on their composition appear capable of many useful applications.

The importance of this subject has been already felt by some very able cultivators of science; many useful facts and observations with regard to it have been furnished by Mr. Young; it has been examined by Lord Dundonald, in his treatise on the connexion of Chemistry with Agriculture, and by Mr. Kirwan in his excellent essay on Manures; but the enquiry is still far from being exhausted, and new methods of elucidating it are almost

continually offered, in consequence of the rapid progress of chemical discovery.

In the following pages I shall have the honour of laying before the Board, an account of those methods of analysing soils which appear most precise and simple, and most likely to be useful to the practical farmer; they are founded partly upon the labours of the gentlemen whose names have been just mentioned, and partly upon some later improvements.

II. *Of the Substances found in Soils.*

The substances which are found in soils, are certain mixtures or combinations of some of the primitive earths, animal and vegetable matter in a decomposing state, certain saline compounds, and the oxide of iron. These bodies always retain water, and exist in very different proportions in different lands; and the end of analytical experiments is the detection of their quantities and mode of union.

The *earths* found in common soils are principally *silex*, or the earth of flints, alumine, or the pure matter of clay, lime, or calcareous earth, and magnesia.

Silex, or the earth of flints, when perfectly pure, appears in the form of a white powder, which is incombustible, infusible, insoluble in water, and not acted upon by common acids; it is the substance which constitutes the principal part of rock chrystal; it composes a considerable part of hard gravelly soils, of hard sandy soils, and of hard stoney lands.

Alumine, or pure clay, in its perfect state is white like silex; it adheres strongly to the tongue, is incombustible, insoluble in water, but soluble in acids, and in fixed alkaline menstrua. It abounds most in clayey soils and clayey loams; but even in the smallest particles of these soils it is usually united to silex and oxide of iron.

Lime

Lime is the substance well known in its pure state under the name of quick-lime. It always exists in soils in combination, and that principally with fixed air or carbonic acid, when it is called carbonate of lime; a substance which in the most compact form constitutes marble, and in its looser form chalk. Lime, when combined with sulphuric acid (oil of vitriol), produces sulphate of lime (gypsum), and with phosphoric acid, phosphate of lime. The carbonate of lime, mixed with other substances, composes chalky soils and marles, and it is found in soft sandy soils.

Magnesia, when pure, appears as white, and in a lighter powder than any of the other earths; it is soluble in acid, but not in alkaline menstrua; it is rarely found in soils; when it does exist, it is either in combination with carbonic acid, or with silex and alumine.

Animal decomposing matter exists in very different states, according as the substances from which it is produced are different; it contains much carbonaceous substance; and may be principally resolved by heat into this substance, volatile alkali, inflammable aeriform products, and carbonic acid; it is principally found in lands that have been lately manured.

Vegetable decomposing matter is likewise very various in kind, it contains usually more carbonaceous substance than animal matter, and differs from it in the results of its decomposition principally in not producing volatile alkali; it forms a great proportion of all peats; it abounds in rich mould, as is found in larger or smaller quantities in all lands.

The *saline compounds*, found in soils are very few, and in quantities so small, that they are rarely to be discovered: They are principally muriate of soda (common salt), sulphat of magnesia (Epsom salt), and muriate and

and sulphate of potash, nitrate of lime, and the mild alkalies.

The *oxide of iron* is the same with the rust produced by exposing iron to the air and water; it is found in all soils, but is most abundant in yellow and red clays, and in yellow and red siliceous sands.

A more minute account of these different substances would be incompatible with the object of this paper. A full description of their properties and agencies may be found in the elementary books on chemistry, and particularly in the system of Chemistry, by Dr. Thompson (2d. edit.), and in Henry's Epitome of Chemistry.

III. *Instruments required for the Analysis of Soils.*

The really important instruments required for the analysis of soils are few, and but little expensive. They are a balance capable of containing a quarter of a pound of common soil, and capable of turning, when loaded with a grain; a series of weights from a quarter of a pound Troy to a grain; a wire sieve, sufficiently coarse to admit a pepper corn through its apertures; an Argand's lamp and stand; some glass bottles; Hessian crucibles; porcelain, or queen's-ware evaporating basins; a Wedgewood pestle and mortar; some filters made of half a sheet of blotting-paper, folded so as to contain a pint of liquid, and greased at the edges, a bone knife, and an apparatus for collecting and measuring aëriform fluids.

The chemical substances of re-agents required for separating the constituent parts or the soil, are muriatic acid (spirit of salt), sulphuric acid, pure volatile alkali dissolved in water, solution of prussiate of potash, soap lye, solution of carbonate of ammoniac, of muriate of ammonia, solution of neutral carbonate of potash, and nitrate of ammoniac. An account of the nature of these bodies,

bodies, and their effects, may be found in the chemical works already noticed; and the re-agents are sold, together with the instruments mentioned above, by Mr. Knight, Foster-lane, Cheapside, arranged in an appropriate chest.

IV. *Mode of collecting Soils for Analysis.*

In cases when the general nature of the soil of a field is to be ascertained, specimens of it should be taken from different places, two or three inches below the surface, and examined as to the similarity of their properties. It sometimes happens, that upon plains the whole of the upper stratum of the land is of the same kind, and in this case, one analysis will be sufficient; but in vallies, and near the beds of rivers, there are very great differences, and it now and then occurs that one part of a field is calcareous, and another part siliceous; and in this case, and in analogous cases, the portions different from each other should be separately submitted to experiment.

Soils when collected, if they cannot be immediately examined, should be preserved in phials quite filled with them, and closed with ground-glass stoppers.

The quantity of soil most convenient for a perfect analysis is from two to four hundred grains. It should be collected in dry weather, and exposed to the atmosphere till it becomes dry to the touch.

The specific gravity of a soil, or the relation of its weight to that of water, may be ascertained by introducing into a phial, which will contain a known quantity of water, equal volumes of water and of soil, and this may be easily done by pouring in water till it is half full, and then adding the soil till the fluid rises to the mouth; the difference between the weight of the soil and that of the

the water will give the result. Thus if the bottle contains four hundred grains of water, and gains two hundred grains when half filled with water and half with soil, the specific gravity of the soil will be 2, that is, it will be twice as heavy as water, and if it gained one hundred and sixty-five grains, its specific gravity would be 1825, water being 1000.

It is of importance, that the specific gravity of a soil should be known, as it affords an indication of the quantity of animal and vegetable matter it contains; these substances being always most abundant in the lighter soils.

The other physical properties of soils should likewise be examined before the analysis is made, as they denote, to a certain extent, their composition, and serve as guides in directing the experiments. Thus siliceous soils are generally rough to the touch, and scratch glass when rubbed upon it; aluminous soils adhere strongly to the tongue, and emit a strong earthy smell when breathed on; and calcareous soils are soft, and much less adhesive than aluminous soils.

V. *Mode of ascertaining the Quantity of Water of Absorption in Soils.*

Soils, though as dry as they can be made by continued exposure to air, in all cases still contain a considerable quantity of water, which adheres with great obstinacy to the earths and animal and vegetable matter, and can only be driven off from them by a considerable degree of heat. The first process of analysis is, to free the given weight of soil from as much of this water as possible, without in other respects affecting its composition; and this may be done by heating it for ten or twelve minutes over an Argand's lamp, in a bason of porcelain, to a temperature equal

equal to 300° Fahrenheit; and in case a thermometer is not used, the proper degree may be easily ascertained, by keeping a piece of wood in contact with the bottom of the dish; as long as the colour of the wood remains unaltered, the heat is not too high; but when the wood begins to be charred, the process must be stopped. A small quantity of water will perhaps remain in the soil even after this operation, but it always affords useful comparative results; and if a higher temperature were employed, the vegetable or animal matter would undergo decomposition, and in consequence the experiment be wholly unsatisfactory.

The loss of weight in the process should be carefully noted, and when in four hundred grains of soil it reaches as high as 50, the soil may be considered as in the greatest degree absorbent, and retentive of water, and will generally be found to contain a large proportion of aluminous earth. When the loss is only from 20 to 10, the land may be considered as only slightly absorbent and retentive, and the siliceous earth as most abundant.

VI. *Of the Separation of Stones, Gravel, and vegetable Fibres from Soils.*

None of the loose stones, gravel, or large vegetable fibres should be divided from the pure soil till after the water is drawn off; for these bodies are themselves often highly absorbent and retentive, and in consequence influence the fertility of the land. The next process, however, after that of heating, should be their separation, which may be easily accomplished by the sieve, after

* In several experiments, in which this process has been carried on by distillation, I have found the water that came over pure, and no sensible quantity of volatile matter was produced.

the soil has been gently bruised in a mortar. The weights of the vegetable fibres or wood, and of the gravel and stones, should be separately noted down, and the nature of the last ascertained; if calcareous, they will effervesce with acids; if siliceous, they will be sufficiently hard to scratch glass; and if of the common aluminous class of stones, they will be soft, easily scratched with a knife, and incapable of effervescing with acids.

VII. *Separation of the Sand and Clay, or Loam, from each other.*

The greater number of soils, besides gravel and stones, contain larger or smaller proportions of sand of different degrees of fineness; and it is a necessary operation, the next in the process of analysiss to detach them from the parts in a state of more minute division, such as clay, loam, marle, and vegetable and animal matter. This may be effected in a way sufficiently accurate, by agitation of the soil in water. In this case, the coarse sand will generally separate in a minute, and the finer in two or three minutes, whilst the minutely divided earthy, animal, or vegetable matter will remain in a state of mechanical suspension for a much longer time; so that by pouring the water from the bottom of the vessel, after one, two, or three minutes, the sand will be principally separated from the other substances, which, with the water containing them, must be poured into a filter, and after the water has passed through, collected, dried, and weighed. The sand must likewise be weighed, and their respective quantities noted down. The water of lixiviation must be preserved, as it will be found to contain the saline matter, and the soluble animal or vegetable matters, if any exist in the soil.

VIII. Ex-

VIII. *Examination of the Sand.*

By the process of washing and filtration, the soil is separated into two portions, the most important of which is generally the finely divided matter. A minute analysis of the sand is seldom or never necessary, and its nature may be detected in the same manner as that of the stones or gravel. It is always either silicious sand, or calcareous sand, or a mixture of both. If it consist wholly of carbonate of lime, it will be rapidly soluble in muriatic acid, with effervescence; but if it consist partly of this substance and partly of silicious matter, the respective quantities may be ascertained by weighing the residuum after the action of the acid, which must be applied till the mixture has acquired a sour taste, and has ceased to effervesce. This residuum is the silicious part; it must be washed, dried, and heated strongly in a crucible; the difference between the weight of it and the weight of the whole, indicates the proportion of calcareous sand.

IX. *Examination of the finely divided Matter of Soils, and Mode of detecting mild Lime and Magnesia.*

The finely divided matter of the soil is usually very compound in its nature; it sometimes contains all the four primitive earths of soils, as well as animal and vegetable matter; and to ascertain the proportions of these with tolerable accuracy, is the most difficult part of the subject.

The first process to be performed, in this part of the analysis, is the exposure of the fine matter of the soil to the action of the muriatic acid. This substance should be poured upon the earthy matter in an evaporating basin, in a quantity equal to twice the weight of the earthy matter; but diluted with double its volume of water. The

mixture should be often stirred, and suffered to remain for an hour or an hour and a half before it is examined.

If any carbonate of lime or of magnesia exist in the soil, they will have been dissolved in this time by the acid, which sometimes takes up likewise a little oxide of iron; but very seldom any alumine.

The fluid should be passed through a filter; the solid matter collected, washed with rain water, dried at a moderate heat, and weighed. Its loss will denote the quantity of solid matter taken up. The washings must be added to the solution, which if not sour to the taste, must be made so by the addition of fresh acid, when a little solution of common prussiate of potash must be mixed with the whole. If a blue precipitate occurs, it denotes the presence of oxide of iron, and the solution of the prussiate must be dropped in till no farther effect is produced. To ascertain its quantity, it must be collected in the same manner as other solid precipitates, and heated red; the result is oxide of iron.

Into the fluid freed from oxide of iron, a solution of neutralized carbonate of potash must be poured till all effervescence ceases in it, and till its taste and smell indicate a considerable excess of alkaline salt.

The precipitate that falls down is carbonate of lime; it must be collected on the filter, and dried at a heat below that of redness.

The remaining fluid must be boiled for a quarter of an hour, when the magnesia, if any exist, will be precipitated from it, combined with carbonic acid, and its quantity is to be ascertained in the same manner as that of the carbonate of lime.

If any minute proportion of alumine should, from peculiar circumstances, be dissolved by the acid, it will be found in the precipitate with the carbonate of lime, and

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it may be separated from it by boiling for a few minutes with soap lye, sufficient to cover the solid matter. This substance dissolves alumine, without acting upon carbonate of lime.

Should the finely divided soil be sufficiently calcareous to effervesce very strongly with acids, a very simple method may be adopted for ascertaining the quantity of carbonate of lime, and one sufficiently accurate in all common cases.

Carbonate of lime, in all its states, contains a determinate proportion of carbonic acid, *i. e.* about 45 per cent, so that when the quantity of this elastic fluid, given out by any soil during the solution of its calcareous matter in an acid, is known, either in weight or measure, the quantity of carbonate of lime may be easily discovered.

When the process by diminution of weight is employed, two parts of the acid and one part of the matter of the soil must be weighed in two separate bottles, and very slowly mixed together till the effervescence ceases; the difference between their weight before and after the experiment, denotes the quantity of carbonic acid lost; for every four grains and a half of which, ten grains of carbonate of lime must be estimated.

The best method of collecting the carbonic acid, so as to discover its volume, is by the pneumatic apparatus, the construction and application of which is described at the end of this paper. The estimation is, for every ounce measure of carbonic acid, two grains of carbonate of lime.

X. *Mode of ascertaining the Quantity of insoluble finely divided animal and vegetable Matter.*

After the fine matter of the soil has been acted upon by muriatic acid, the next process is to ascertain the quantity

tity of finely divided insoluble animal and vegetable matter that it contains.

This may be done with sufficient precision, by heating it to strong ignition in a crucible over a common fire till no blackness remains in the mass. It should be often stirred with a metallic wire, so as to expose new surfaces continually to the air; the loss of weight that it undergoes denotes the quantity of the substance that it contains destructible by fire and air.

It is not possible to ascertain whether this substance is wholly animal or vegetable matter, or a mixture of both. When the smell emitted during the incineration is similar to that of burnt feathers, it is a certain indication of some animal matter; and a copious blue flame at the time of ignition, almost always denotes a considerable portion of vegetable matter. In cases when the experiment is needed to be very quickly performed, the destruction of the decomposible substances may be assisted by the agency of nitrate of ammoniac, which at the time of ignition may be thrown gradually upon the heated mass in the quantity of twenty grains for every hundred of residual soil. It affords the principle necessary to the combustion of the animal and vegetable matter, which it causes to be converted into elastic fluids; and it is itself at the same time decomposed and lost.

XI. *Mode of separating aluminous and silicious Matter and Oxide of Iron.*

The substances remaining after the decomposition of the vegetable and animal matter are generally minute particles of earthy matter, containing usually alumine and silex with combined oxide of iron.

To separate these from each other, the solid matter should be boiled for two or three hours with sulphuric acid, diluted with four times its weight of water; the

quantity

quantity of the acid should be regulated by the quantity of solid residuum to be acted on, allowing for every hundred grains two drachms or one hundred and twenty grains of acid.

The substance remaining after the action of the acid, may be considered as silicious; and it must be separated and its weight ascertained, after washing and drying in the usual manner.

The alumine and the oxide of iron, if any exist, are both dissolved by the sulphuric acid; they may be separated by carbonate of ammoniac, added to excess; it throws down the alumine, and leaves the oxide of iron in solution, and this substance may be separated from the liquid by boiling.

Should any magnesia and lime have escaped solution in the muriatic acid, they will be found in the sulphuric acid; this, however, is scarcely ever the case; but the process for detecting them and ascertaining their quantities, is the same in both instances.

The method of analysis by sulphuric acid, is sufficiently precise for all usual experiments; but if very great accuracy be an object, dry carbonate of potash must be employed as the agent, and the residuum of the incineration must be heated red for a half hour, with four times its weight of this substance, in a crucible of silver, or of well-baked porcelain. The mass obtained must be dissolved in muriatic acid, and the solution evaporated till it is nearly solid; distilled water must then be added, by which the oxide of iron and all the earths, except silex, will be dissolved in combination as muriates. The silex, after the usual process of lixiviation, must be heated red; the other substances may be separated in the same manner as from the muriatic and sulphuric solutions.

This process is the one usually employed by chemical philosophers for the analysis of stones.

XII. *Mode of discovering soluble animal and vegetable Matter, and saline Matter.*

If any saline matter, or soluble vegetable or animal matter, is suspected in the soil, it will be found in the water of lixiviation used for separating the sand.

This water must be evaporated to dryness in an appropriate dish, at a heat below its boiling point.

If the solid matter obtained is of a brown colour and inflammable, it may be considered as partly vegetable extract. If its smell, when exposed to heat, be strong and fetid, it contains animal mucilaginous or gelatinous substance; if it be white and transparent, it may be considered as principally saline matter. Nitrate of potash (nitre) or nitrate of lime, is indicated in this saline matter, by its scintillating with a burning coal. Sulphate of magnesia may be detected by its bitter taste; and sulphate of potash produces no alteration in solution of carbonate of ammoniac, but precipitates solution of muriate of barytes.

TO BE CONCLUDED IN OUR NEXT.

On rearing Calves.

In a Letter to Lord SHEFFIELD, *anonymous.*

From the COMMUNICATIONS to the BOARD of AGRICULTURE.

THE following is the method I have pursued with great success in weaning my calves.

The calf should be taken away when about a week old, (or when the cow's udders are perfectly cleansed from all hardness,) and kept at a distance, out of the hearing of their mothers. For the first few days (according to the strength of the calf) my servant gives them *new milk*

milk, and by dipping their mouths in the milk it will soon entice them to drink; but gradually lowering the *new milk* to that which has been skimmed. The skimmed milk should have a piece of red hot iron plunged in it, not only to warm it, but to give it an astringent quality; but should the calf scour on the change of milk, I have always found a table-spoonful of Bigg's Calves Cordial, given daily for a short time, always remove it. At about three weeks old the calves will begin to lick up bran, bruised oats, &c. and pick a little hay. When that is the case, powder some oil-cake very fine, and mix it with the bran, &c. in the manger: in a very short time they will eat it greedily in small pieees; *the taste they never forget*, so that there is not any trouble in fatting them when grown up.

I generally, as my calves come soon after Christmas, keep them tied up till April; but when they fall later in the spring, they may be let out in the middle of the day for a little grass, still giving the oil-cake and bran, but lowering the milk with water till the milk is quite taken off. When a calf falls at Christmas, about February I give him some cut potatoes, but carrots or parsnips are better. About Midsummer they lose a little blood; or if any calf should at any time not keep what his companions, he should be bled, as the oil-cake thickens their blood more than common food. By the above method you get your full dairy in the winter, and your calves do not fall off as when they are taken from the cows at twelve or fifteen weeks old, but continue the whole summer full and straight in the carcase.

I would much recommend about four table-spoonsful of Bigg's Cordial, to be given to the cows about an hour after calving, in a quart of warm ale, particularly if the weather is wet and cold.

 De-

Description of an Horse Engine, for raising Coal or Ore from Pits, in which the Buckets are made to alternate their Direction, without reversing the Motion of the Horse. Invented by Mr. J. WHITLEY BOSWELL, *and communicated by him.*

With a Plate.

GENTLEMEN,

HAVING lately seen an account of a method of reversing the motion of the buckets in engines for raising ore, without altering the direction of the first mover, invented by a French gentleman, I am reminded by it of an engine which I contrived for the same purpose several years ago; of which I take the liberty to send you a description, for your publication: as it is considerably simpler than the French engine, not requiring half the number of parts, while it is at least equally effectual.

In the year 1796 I made a model of this engine by the desire of some gentlemen, who were concerned in a speculation for raising culm near Barnstaple in Devonshire; and as the Society of Arts had offered a premium for such an invention about this time, I sent them this model in the ensuing year, which lay for inspection at their house in the Adelphi for a considerable time; for, though I could not be a candidate for the premium offered on this occasion, as I had no opportunity of having the engine made on a large scale and put to work, (which was an essential condition directed by the Society for this premium); yet I always hold myself bound to contribute to the views of the Society, in return for the honour conferred on me by them before that period, of one of their highest premiums for another machine of my invention, which is described in their Transactions.

The

The usual method by which buckets, for raising ore from pits, are caused to alternate their direction, is to oblige the horse, which puts the machinery in motion that works them, to turn about and retrace his steps the contrary way.

This operation is found to fatigue the horse very much; and as he must turn about in a very small space, the constrained movement necessary for this purpose is very injurious to his shoulder, which runs much risk of dislocation thereby; for this reason this contrivance is of considerable utility, and may eventually cause much saving by its adoption.

The figure which accompanies this paper is exactly that of the model; which for this matter sufficiently prooves the principle; for the object is only the conversion of one motion into another in a required manner; and does by no means involve the consideration of the relative value of the moving power to that of the thing to be moved; in which latter case models in themselves give no absolute demonstration of the performances of a large engine; though in the former they certainly do.

Description. (See Plate VI.)

An horizontal wheel A, Fig. 3, toothed on its face, is turned round with the upright arbor, to which it is made fast, by the arm G; above this wheel two vertical pinions, or small wheels, B B, toothed at their edges, are fastened to an horizontal axis in such a manner, that only one of them can lock in the teeth of the large wheel at once; this axis also carries the drum wheel C, which raises the buckets D from the pit, and is capable of sliding back and forwards in the sockets, in which it turns, far enough to admit the pinions to come in contact alternately with the teeth of the large wheel: a lever E, jointed

jointed to the upper part of the frame-work, gives the axis this motion; the end of the axis turns round in a hole in the upper part of this lever, and a projection on the axis at each side of the lever obliges it to move back and forwards as the lever is impelled to or from the upright post next it; an hook F fastened to the lower part of the lever, keeps it steady in either position, according as it is inserted into the eye, or ring, next the lever, or that farthest from it.

The frame-work, which supports the various parts of the engine, is sufficiently obvious, from the figure.

When the motion of the buckets is required to be reversed, it is plain, from the above description, that it is only necessary to change the position of the lever, and insert the hook into the opposite ring; this will cause the pinion, which before was moved by the large wheel, to be removed from all contact with it, and at the same time bring the opposite pinion into play; which, as the pinions are at opposite sides of the large wheel, must cause the axis to turn round in a contrary direction, and of course the drum for raising the buckets likewise, which will thereby alternate their former direction.

It is very obvious that this engine admits of various modifications; for example, it is not absolutely necessary that the drum should be on the same axis as the pinions; it is sufficient if the circular motion of the one is communicated to the other: the axis of the drum also need not slide back and forwards in its sockets; that of the pinions alone requires this motion: there are many obvious ways of giving the circular motion of one to the other without the sliding motion, a fork on the end of one axis, and a cross on that of the other playing within it, is alone sufficient for the purpose.

The horizontal wheel may also be much smaller in proportion than what is represented in the figure; but then

then the drum must be adequately increased in size, if this diminution takes place, otherwise the buckets would not move fast enough: this would most probably be the cheapest way to construct a large engine on those principles; and in this case it would also be best to have the drum and pinions on separate axes, in the manner just above described.

There remains only one inconvenience to be guarded against in the construction of the engine: if the pinions B B are placed so far asunder that they can both be out of contact with the large wheel at the same time, it is obvious there would be nothing to prevent the ascending bucket (in such a position of the engine) from running down again; this accident was prevented in the model, by making the teeth of the pinions broader than those of the large wheel, and fixing the said pinions at that exact distance from each other on their axis, that one of them always must come in contact with the large wheel before the other was entirely thrown out of play; the same might likewise be effected by catches placed properly over the pinions, so that the pinions would come into contact with them, and be removed from it alternately, as the axis was shifted back and forwards.

If the same method used in the model be adopted for this purpose in a large engine, it will be necessary to stop the horse always, before the lever is shifted, to prevent damage to the teeth of the wheels.

I am, Gentlemen, your, &c.

J. W. Boswell.

Experiments

Experiments and Observations on the fining and clarifying of Wines, Malt Liquors, &c. By M. Parmentier.

(Concluded from Page 59.)

Chemical Action of some Re-agents upon Isinglass and Flanders Glue.

A SOLUTION of isinglass mixed with alcohol at 33 degrees yielded me a precipitate, white, flakey, and tremulous, like animal jelly, but which dissolved only in a partial manner, either in cold or in boiling water.

Flanders glue dissolved in water, and treated like the former, yielded a more voluminous precipitate, which dissolved but imperfectly in water at any temperature.

Pure crystallized gallic acid dissolved in alcohol, acts but very slowly upon fish-glue. The mixture did not become turbid till after standing two hours: a slight deposition then occupied the bottom of the vessel, which was insoluble in water.

Flanders glue treated in the same manner acquired by this mixture a little more consistence; the slight sediment which was formed was more coloured and insoluble.

Alcohol digested upon galls dissolves not only the gallic acid, but also the tanning principle, which this substance contains, so that when this tincture is mixed with the fish-glue, two precipitates are formed, which may easily be distinguished by the disposition of their flakes as well as by their colour, the one being whitish, scanty, and in part soluble in water, the other of a brownish colour, very elastic, insoluble, and which, after two or three days exposure to the air, acquires a horny consistence. These two precipitates may be separated: the first is separated by decanting the liquid, which remains whitish and turbid, and soon deposits the second.

Flanders

Flanders glue, treated like the preceding with tincture of galls, affords similar results, with this difference only, that the deposits are more considerable and more coloured.

The sulphuric, nitric, muriatic, and acetic acids, mixed with the solution of isinglass, destroy its transparency After standing for some hours, it is easy to perceive a slight sediment at the bottom of the vessel. If the three first of these acids are concentrated, this mixture with glue soon becomes black.

Common glue treated in this manner presents the same phenomena. The alkalies render these two solutions more liquid, and acquire much more colour.

A solution of isinglass mixed with the aqueous tincture of turnsole, in Dutch cakes, undergoes no alteration.

Attention ought to be paid to this re-agent, upon which the most caustic alkalies exert no discolouring action. The chemists do not cease to repeat in their works, that the alkalies change the violet colour of turnsole into a green, but this assertion is false with respect to turnsole in cakes; this may easily be tried, and it will be seen that instead of changing this colour the alkalies augment its intensity and lustre. The surprise which this circumstance may occasion will cease when it is considered that in the preparation of this substance the Dutch employ potash and quick-lime, for the purpose of developing its colour; it is, however, possible that the tincture of turnsole on cloths may compose itself in an entirely different manner with this gelatino-albuminous matter, which I have not yet been able to ascertain.

Flanders glue mixed like the fish glue with tincture of turnsole, presents the same result.

Syrup

Syrup of violets, mixed with isinglass and Flanders glue dissolved in water, does not appear sensibly to change its colour.

Alcohol macerated upon isinglass does not dissolve it; but if it is mixed with water, and the mixture is heated in a close vessel, the solution of the glue then takes place. There is observed at the surface of the liquor a frothy matter, insoluble in water, which has appeared to me to be only a portion of the alumine of this glue coagulated by the united action of the heat and the alcohol: it is in this state that this solution is fit for the preparation of the English glazed taffety as it is termed.

From these observations, and several others which it would be unnecessary here to enumerate, it appears, 1, that isinglass is a gelatinous substance, different from albumen; 2, that it presents in general the same principles as pure gelatine; 3, that it however differs from it by some particular characters.

In the first place, isinglass, compared with Flanders glue, has less specific weight; though it glues substances together more speedily, it does not do it with equal solidity, which indicates less tenacity in its parts than in those of the glue extracted from the skins and bones of quadrupeds.

Secondly, its inferior density proves also that it is neither so nourishing nor so substantial as the gelatine extracted from other animals; accordingly when it is burnt it furnishes less coal than an equal weight of Flanders glue.

The different properties of the fish glue in some of the arts are known to the ribbon-manufacturers, who employ it for giving lustre to their goods; to the serge-manufacturers, who use it for glazing the stripes of their stuffs, &c.; finally, it is one of the principal substances employed

ployed for imitating fine pearls; but its most frequent domestic use is for the clarification of liquids, and especially of white wines. Let us now compare its effects with those of albumen employed under the same circumstances.

Of the Effects of Albumen composed with those of Isinglass in the Clarification of White Wines.

I requested M. Henry, Professor at the School of Pharmacy in Paris, to make some comparative experiments upon the clarification of red and of white wines with the aid of albumen and of isinglass, always following the process adopted in domestic economy. The results which he obtained are as follows:

He perceived no sensible difference, as to transparency, between red wine clarified either with isinglass or with albumen, excepting that the latter yielded a more abundant deposit, which is frequently owing to its abode in the casks.

His first experiments were made upon white wines furnished to the central pharmaceutical magazine of hospitals, without his being precisely acquainted with the places from which they had been procured.

These wines were clarified by whites of eggs much better than by isinglass; but similar trials, repeated with white wines of Maçon, had not the same success, for they exhibited only a semi-transparent aspect.

Surprised at this difference, M. Henry investigated its cause, which he thought to discover in the nature of the wines upon which he operated. Those who furnished them confessed that the first wines which they had supplied were a mixture of several different wines, among which those of the vicinity of Bourdeaux were the most predominant.

As to the white wines of Burgundy, and the other provinces where the vine is cultivated, as far as the upper Marne, the best means of clarifying them is to employ isinglass for the white wines, and albumen for the red.

M. Henry has, however, succeeded in clarifying red wines of Maçon with isinglass dissolved in a small quantity of spring-water. Flanders glue, which he likewise tried, not only does not completely clarify the wines, but it also communicates to them a disagreeable taste; they soon change their colour, and in a short time begin to spoil.

The experiments which I have made with the same views, have afforded me nearly the same results. It cannot be doubted that the advantages of isinglass over white of egg are very sensible for the white wines of most provinces, that it clarifies them in a short time in a satisfactory manner, that it even affords a means of causing the yellowish cast, which they sometimes naturally have, to disappear, by mixing it with milk, and putting the whole into the vessel.

White of egg, on the contrary, when employed for white wines, always colours them, and does not clarify them. It is proved, that most of the white wines which have been fined by this means retain a greater or less degree of turbidity, and that they are never perfectly clear. This means has also advantages over isinglass: being more viscous and heavier it carries along with it much better the tartarous and extractive parts, which are more abundant in red than in white wines, and clarifies them more completely. Isinglass on the contrary is light; it remains suspended in the red wine with the parts which it has not the power to carry off with it.

In Germany, white of egg is seldom or never employed for fining wines; isinglass is generally preferred, and the former

former is used only in some cases for clarifying wines contained in barrels or casks.

The dealers, when interrogated by M. Bounach respecting the clarification of wines, and the reasons why they preferred isinglass to white of egg, replied that they did it for several reasons: in the first place, because, when the former substance was used, only a very small quantity of it was required for fining a great deal of wine, whereas, when they employed the latter, they were obliged to use too large a quantity of it, which frequently injured the quality of the liquor; that moreover the whites of eggs were too raw, or, in other words, they were not sufficiently animalized; for the more a substance has of this character, the better adapted it is for the clarification of fluids. Blood is more animated than the other animal matters, and it produces in this case, the greatest effect.

Experiments upon Brewers Glue.

Having procured a quantity of the glue which the brewers prepare for fining and clarifying malt-liquors, I subjected it to chemical examination.

It was of a yellowish colour, of the consistence of a syrup; its smell was the same as that of beer; and it was full of air-bubbles. Its taste, which was slightly acid and spirituous, like a decoction of barley fermented, and without hops, indicated that this glue had been dissolved in malt-liquor. It reddens the tincture of turnsole, because it is slightly acidulous. This glue, when mixed with alcohol, curdles without losing its transparency, in the same manner as gelatine; the acids do not coagulate it; the alkalies contréte it a little, and if they are caustic they turn it brown and dissolve it.

The effects of blood are well known in the refining of sugar; the brewers also use the serum, when it is well separated from the coagulum, although they are in general very cautious of avowing it, on account of the aversion which most persons would have against such a substance; nevertheless, this fluid, whether fresh or not, if beaten up with a little water or liquor from the casks into which it is poured, clarifies very well.

In the treatises which contain some good observations on the preparation of beer, there prevails much uncertainty respecting the real matter which the brewers employ for the fining and clarification of this liquid. Some authors assert that it is clarified like white wine, that is to say, with isinglass, and the preparation of it which they specify is precisely the same as that which is used for wine. Other writers who admit that the gelatinous matters are the most efficacious for fining beer, have given no farther explanation on this head; they merely mention gum arabic as very well adapted for this operation; nevertheless it is very rarely used, on account of its high price and the consistence which it gives to the liquor, which, in the opinion of the brewers, renders it less sparkling, less delicate, and much inferior in quality to the beer into the composition of which animal substances enter.

In order to remove all uncertainties on this subject, I determined to make other experiments upon the liquid glue commonly used by the brewers, which the solution of tannin in alcohol or water precipitates like a tanned substance.

From these it results, that the glue which many brewers employ is nothing more than animal gelatine dissolved in beer; that this gelatine has no resemblance in smell, taste, transparency and other qualities, to isinglass,

isinglass, but that it is entirely of the same nature with white Flanders glue, which is a new proof that animal gelatine may serve to clarify vinous liquors.

I am far from believing that the glue of all brewers has constantly Flanders glue for its base. I have examined several which were prepared with isinglass. It is a circumstance very likely to happen, that under such circumstances where this article, instead of four or five francs, which is its ordinary price, is sold as high as sixteen francs the pound, Flanders glue, which is always cheaper, is used as a substitute for it.

But M. Bounach, first apothecary of the military hospitals, who has had occasion to frequent the most celebrated breweries of Germany, and attentively to observe the operations carried on in them, has remarked that neats' or calves' feet are used for fining the liquor, and that they are boiled until no more remains of them than the fibres and the bones; he has also remarked that in places where the consumption of beer is very great, it frequently happens that the butchers not being able to furnish a sufficient quantity of neats' or calves' feet for the supply of the brewers, recourse is had to other substances of this nature. He recollects having seen a whole calf thrown into the boiler, after the fat has been separated. The cartilaginous fishes are also used for the same purpose where the local circumstances admit of it.

There is a means of clarifying wines, which appears to be very little known, or at least is very seldom employed, but which however is pretended to prove always very successful. It consists in throwing into the cask a quantity of sheep's blood proportionate to the gage; but it must be used very quickly, for nothing corrupts

more

more speedily than this fluid, on which account it must not be employed where it is necessary to send it to a great distance; in these cases one must use other animal matters, which, when reduced to the consistence of a solid cake, can be better preserved and transported from place to place.

We ought not to be surprised that chemists have found in the lees of beer and of wine an animal gluten. I believe that they have not paid sufficient attention to the isinglass, or serum of blood, or whites of eggs, with which these liquors are clarified, and which deposit themselves in the lees. This gluten is so abundant in the lees of beer as to prevent it from passing through the canvas of the sacks into which it is poured. As the serum of blood is albuminous and isinglass glutinous, we may discover in the lees of beer or of wine which of the two substances has been used for clarifying these liquors. These lees when putrefied exhale a highly-animal odour, especially when vinegar is manufactured with them.

The clarification of wines and of beer whether effected by isinglass or by Flanders glue, leaves in the lees an animal gluten, which, by its decomposition, affords ammoniac, like animal substances in a state of putrefaction. Isinglass in particular does not yield less of this gluten than any other glue made from skins, the whites of eggs or the serum of blood; it even appears to be more susceptible of putrefaction than any other, and a disagreeable fishey smell is exhaled from it. Thus the lees of malt-liquor or of wine always contain an animal gluten, whatever may be the nature of the glue that has been employed,

Phenomenon

Phenomenon of Clarification.

Among the substances employed for the clarification of liquors, we observe that albumen possesses this property in the highest degree; then the serum of blood, animal gelatine (glue) isinglass, milk, &c.; but how do these different matters act upon the foreign substances contained in the liquids which are to be freed from them? It is, some say, by inveloping them during the time when they first coagulate; having then become more heavy, they are compelled to precipitate themselves and carry with them all the heterogeneous substances with which they are entangled.

These facts, which are well substantiated by the common practice of clarification, appear to have been hitherto examined only as a purely mechanical operation. It seems to me that a more satisfactory explanation might be given of the phenomenon, which determines the formation of the precipitate which takes place, as well as of the causes which concur with the greatest efficacy in the clarification of the liquids.

I think that the clarification of liquids may be considered as a chemical action, and assert that when it takes place in an alcoholic liquor, such as wine, mead, malt-liquors, &c. it is the more complete in proportion as the clarifying substance contains a larger quantity of albumine. In fact, if we bring it into contact with alcohol, the first of these substances is solidified or coagulated to such a degree as to become insoluble in most liquids, and this solidification is always in direct proportion to the strength of the alcohol, so that the albumine, having acquired a greater density, is soon precipitated. If, instead of pure alcohol, we employ it diluted with water, the albumine which is mixed with it is coagulated more slowly,

slowly, because the action of such alcohol upon this substance is necessarily less energetic. If the liquid is ordinary wine, we easily see that, containing principles besides the alcohol, these may concur in the coagulation of the albumine. Such are the acids, whether free or united with the salts ready formed in the wine, such, for example, as the tartarous acidule. By mixing albumine with this wine, for the purpose of freeing it from the matters which, without being dissolved in it, remain suspended in it to destroy its transparency, as well as its durability, it happens that the alcohol acts alone upon the albumine, or in combination with the tartarous acidule, and that, concreting but slowly, because the alcoholic and acidulous mass is disseminated in too large a quantity of vehicle, which necessarily modifies their action, this albumine has time to envelope and to determine the separation of all the substances which render the liquid turbid, and to carry them along with it in its precipitation.

What the acid and alcoholic liquors produce upon albumine, is effected likewise by the action of heat, of which the clarification of sugar, of honey, &c. in the preparation of syrups, afford as many examples. In fact, whenever we heat in any considerable degree albumine either alone or diluted with water, whether this contains sugar or any other matter in solution, it experiences a more or less speedy coagulation, which frees the mixture from those foreign substances which are soluble only in water. Here it is undoubtedly the combination of the caloric with the albumine which solidifies it, whereas in the first case it is the sole or simultaneous action which the acids and alcohol exert upon it.

The serum of blood, treated in the same manner, comports itself like albumen, so that the strongest analogy

may

may be considered to exist between these two substances; analysis also has decided in favour of this opinion.

If, instead of employing albumen or the serum of blood for clarification, we use Flanders glue, isinglass, milk, &c. these different matters produce this effect, for two plausible reasons; the first, because these depurating substances (especially glue and isinglass) are formed of a very large quantity of gelatine, the albumine not amounting perhaps to a five hundredth part of their mass, and this gelatine dissolves in the liquor which is to be clarified, renders it more viscous, and diminishes to a certain degree the coagulating action of the alcohol or the vegetable acids upon the albumine which this gelatine contains; at the same time it greatly retards the precipitation of the foreign matters, when, the albumine not being in sufficient quantity in proportion to the liquid mass, upon which the action takes place, the clarification can of course not be effected till after a considerable length of time. I am led to believe, from some experiments which I have made upon glue and isinglass, that these two substances contain a certain quantity of albumine, and that it is particularly from this matter or from one analogous to it, that they derive the property which they possess of clarifying liquids; for, according to the opinion of some chemists, the gelatinous substance may be considered as albumine carried to the highest degree of oxygenation; that albumine employed pure acts with a promptitude and perfection which bears no comparison with the effect produced by the other substances in which this property is observed; that the quantity of gelatine which the different glues leave in solution in the liquids, clarified by them, not only augments their density and viscosity, but also disposes them to a speedy deterioration. A single example will suffice to prove this fact. In several

of our departments, particularly in those of the north, the Ardennes and other of the Belgic provinces, the great quantity of beer which is made in them is clarified with nothing else than the feet of sheep, of calves, oxen, &c. I have even seen them frequently throw a whole new-dropt calf into a beer-vat.

What can be the result of this operation unless the solution in the liquid of a very large quantity of that mucoso-gelatinous substances of which all these animal parts are formed? The fermentation which this liquid is afterwards made to undergo, disorganizes indeed this gelatine; but it is precisely in this decomposition that the source of the matter which must concur to the destruction of the beer is to be found. The carbonic, acetous, malic and mucous acids are the products resulting from this fermentation; some are disengaged, the others are precipitated; the acetous and the malic remain in solution; their acid energy increases with time, and the beer, in a word, is no longer drinkable after it has been six months in barrel. If this liquor undergoes only an imperfect fermentation, a portion of this gelatine remains in it unchanged, gives much consistence to the beer, renders it disagreeable to drink, heavy, and difficult of digestion.

When beer is clarified after it has undergone fermentation, as is practised with that brewed at Louvain, Anvers, Brussels, Mastricht, &c. where this beverage is superior in quality to that of our antient departments, and use is made of glue or isinglass, little of these matters is employed for the pale beers, so that the alteration of these is less perceptible and less speedy, because they are much more alcoholic and less charged with foreign and colouring matters. There are some beers which

which keep as long as three years, even in casks; but they always become at length acid some time after.

A fact which tends to support what I have advanced respecting the eminently-clarifying property of albumine, is that wine was discoloured by white of egg, and a very abundant deposit formed at the bottom of the vessel which contained it, whilst such as had been clarified with isinglass neither lost its colouring part nor yielded so abundant a deposit. M. Payssé has repeated these experiments, and the results which he obtained were exactly similar to mine.

I have frequently had occasion, in preparing liquors for the table, to seek for means of obtaining them white or colourless. That which has succeeded the best with me is the solution of white sugar in cold water, mixed afterwards with the alcohol, and some whites of eggs beat up with it. Three or four days are generally sufficient for the complete depuration of the liquid. The sediment which is formed is very considerable, and the liquor easily passes through the filters.

I here frequently substituted isinglass in the place of white of egg in this operation, as also milk and cream; but besides that these substances take a much longer time to clarify the liquors, the latter are never so limpid nor so free from colour as those which are treated with white of egg: they also retain a consistence which gives them an oily aspect, and they do not pass through the filtering paper without the greatest difficulty.

Hot milk and cream are also to be ranked among the clarifying substances; they even act pretty speedily; but there results from their use, especially from that of the first of these substances, a serious inconvenience, namely that of leaving in the liquor a certain quantity of serum which it is impossible to separate from them, and which ne-

cessarily injures the delicate taste of this kind of aromatic liquors.

Pure washed sand is, as we have already observed, a substance very well adapted for clarification; it is at the same time very cheap, and it acts mechanically.

Powdered charcoal, well washed, has also the same advantages under certain circumstances.

The metals, and especially lead in small grains, are substances very well adapted for effecting not only the clarification of fatty substances, but also their complete discolouration. The action of this metal upon the oils must not, however, be ranked in the class of the mechanical means. It is not by its great weight that this metal compels the colouring and mucous matter of the oils to precipitate itself; the operation is more complicated; it is a chemical one, of which the following circumstance affords a proof. Leaden shot put into a vessel with oil, first becomes oxydated at its surface, by means of the decomposition of a portion of water which the mucilage of the oil retains. When the oxydation has once commenced, the attraction of the colouring matter of the fatty substance is exercised by this oxyd, and thence, the separation of the oil; the mucous matter, in its turn, not being combined with the substances which favoured its union with the fatty substance, is precipitated, and augments the deposit already formed; the oil then becomes almost colourless, acquires much more fluidity, loses its property of congealing, burns with a brilliant flame, and gives out hardly any smoke.

General Reflections.

If we attentively examine the question treated in this memoir, we shall be disposed to believe, that of all the substances proper for the clarification of liquids and for giving

giving them that perfect limpidity which they cannot acquire and keep by mere repose and filtration, the albumine is the best adapted for the purpose, on account of the celerity and the perfection with which it produces its effect, and particularly on account of the little alteration which the liquors experience from its action. Perhaps even the animal gelatine possess this property only by reason of the albumine which they contain; but that, among the substances of this kind, the isinglass is preferable to the Flanders glue, because it is almost entirely colourless, insipid, and communicates no disagreeable quality to the liquors that are clarified by this means; that, considered in an economical point of view, the first is the most advantageous.

It is observed, that most of the white wines which are clarified by means of isinglass are more transparent and preserve their limpidity longer than those which are clarified with whites of eggs; for those, when exposed to the contact of the air, soon lose this limpidity.

As to the red wines, I think it would be proper to make a new trial of isinglass, which, in my opinion, might advantageously supply the place of white of egg, since a much less quantity of it is required for an equal quantity of wine; but there is no doubt that its clarifying action depends upon the nature and the proportions of the principles of which the fluids upon which it is exerted consist, and that it would not be practicable to employ the same method for all the kinds of wine which require more or less time for attaining the maximum of their perfection as beverage, and that this method ought to be determined according to the knowledge of the composition of the liquor which is to be clarified.

There is here one object to be taken into consideration, namely economy. Isinglass is equally capable of clarifying

rifying all sorts of white and of red wines, consequently of affording a substitute for the enormous quantity of whites of eggs which are consumed in this domestic operation, and restoring to the general mass of alimentary substances a valuable article, for which we have no substitute.

In the report delivered to the *Bureau de Consultation* on the glue from bones proposed by M. Grenet, inserted in the Annales de Chimie, April 1792, Vol. XIII. p. 192, M. Pelletier and myself have proved, that under a number of circumstances in which a solution of isinglass is employed, there might be advantageously substituted for it a white jelly prepared by boiling rasped bones for a short time in the least possible quantity of water.

But might we not substitute, in the place of isinglass itself, some analogous matter from among our own indigenous productions? How many substances adapted for this purpose, are not rejected in our fisheries! In his *Systeme des Connoissances chimiques*, M. Fourcroy has not neglected the examination of isinglass: he considers it as an alimentary and a medicinal substance, and he proposes to prepare it with all the parts, and especially with the air-bladders of fishes, of large size.

This project would well deserve to be followed up by some of our chemists who have the most experience in matters of this kind. I should wish, for example, that our colleague M. Seguin, who has treated the albuminous and gelatinous matters with such success, might make it the object of his experiments and researches, that he might determine what is the most economical and most proper means to be employed for the clarification of our vinous liquors, and indicate the reason why in some of the western wine-countries, for example, the inhabitants avoid the use of isinglass for clarifying their white wines, which in transparency

parency and limpidity are by no means inferior to the white wines of the northern departments, for which the use of isinglass is considered indispensable. We shall then at length be exempted from the necessity of procuring from a great distance a substance for which our own natural resources may afford an easy substitute. Let us never lose sight of this truth, that a nation is only in that proportion powerful and rich, as she can dispense with the assistance of others, especially in whatever relates to alimentary substances.

On the Thermometers of baked Earths termed Pyrometers. By M. Fourmy.

From the Journal des Mines.

The phenomena which result from the action of caloric upon certain substances, differ according as the temperature is more or less elevated, more or less constant.

The necessity of comparing these phenomena is felt in an infinite number of circumstances, and especially in most pyrotechnic operations; and yet it will not be possible to compare them until we shall be able to calculate the power of their cause, namely, the *intensity of the caloric*.

The first step to be taken is, therefore, to seek for the means of appreciating this intensity.

As it could not be measured by itself, it has been endeavoured to measure it by its effects. Hence the different instruments, more or less ingenious in their construction, which are known by the name of *thermometers*.

Such of these instruments as are founded upon the principle of the dilatation of mercury or of alcohol, can be employed

employed only for the inferior temperatures; others are required for the more elevated.

The expansion which most solid substances experience when they are penetrated with caloric, was a phenomenon too well known not to suggest the idea of applying them, for the higher temperatures, to the same purposes to which alcohol and mercury are applied for the lower.

Now as the most dilatable of the solids seemed to promise the greatest advantages for this distinction, the metals were naturally the first which occurred to the minds of those who occupied themselves with this research.

Experiments were accordingly made to construct thermometers founded upon the dilatation of the metals.

A phenomenon of a diametrically opposite kind, seemed likely to answer the same purpose.

It was known that the aluminous mixts, called *clays*, experience, from the action of caloric, a more or less sensible diminution of volume, which is generally termed *shrinking*.

The illustrious Wedgwood conceived the idea of applying this property of the clays to the same purposes as the dilatation of the metals *.

He supposed that it was proportionate to the intensity of the caloric, and that it might become the means of measuring it.

* The Editor of the *Annales des Arts* asserts, that Mortimer, who, about the middle of the last century, employed himself upon metallic thermometers, foresaw that pieces of pipe-clay might be capable of indicating higher temperatures than the thermometers founded upon the dilatation of metals; and on this subject he quotes a Memoire by Mortimer, which is inserted in the *Philosophical Transactions* for the year 1747. Nothing however is to be found in this memoir relative to this assertion.

In

In a memoir addressed to the Royal Society of London, in 1782, this artist, after having spoken of the dilatation of mercury and alcohol, says, that

"The thermometers which are now offered to the public, are founded upon an effect entirely opposite, but equally constant, uniform, and capable of being measured, namely, the diminution produced in the volume of argillaceous earths and stones.

This diminution begins to take place at a low red heat, and increases regularly in proportion to the augmentation of the heat, till the argil *arrives at the point of vitrification* *, and consequently at a higher degree of temperature than furnaces or vessels of earth are able to support.

I have found that very good argils, of the kind least subject to vitrification, have lost, in my briskest fires, considerably more than a fourth of their volume.

The contraction, therefore, of this kind of matter, affords as accurate a measure for the higher degrees of heat, as the dilatation of mercury or of alcohol does for the lower."

Such is in substance the opinion of this artist. I propose to examine in how far it is well founded.

The unfruitful design to expose an error into which an artist of such distinguished merit has fallen, is not the object, which has induced me to take up my pen.

* This mode of expression seems to imply that it belongs to the nature of argils to undergo vitrification, and that consequently there is a point, beyond which furnaces or vessels of earth can no longer support the action of caloric.

This two-fold error which, it appears, the author still entertained when he made his thermometer pieces, must necessarily have been discovered by him to be such in the sequel; for the pieces which he composed some years after, "*never*," he says, "assumed the slightest appearance of the semivitreous contexture." See page 151.

 I have

I have seen this error entertained by men very well informed upon every other subject, but who have not had the opportunity to observe the phenomena resulting from the action of caloric upon the aluminous mixts.

The length to which it has been carried has appeared to me of sufficient importance to merit a discussion, in which I have the more readily engaged, as several of the principles upon which I shall endeavour to support it, are either entirely new or very little known.

In order that any effect shall become a fit measure for a cause, it is necessary that it result *solely* and *invariably* from that cause, and *that it be necessarily proportionate to it.*

Let us see whether these three conditions are combined in the effect adopted for measuring high temperatures.

1. Several circumstances concur to modify the action of caloric upon the aluminous mixts.

It is well known that, at any temperature, these mixts experience a shrinking, which is the more considerable the longer they are exposed to it. It is even found that at a continued temperature, they shrink as much as at another which is higher, but not applied for as great a length of time.

It is likewise an incontestible fact, that a very quick application of fire does not leave the earthy particles the property of approaching each other so closely as they would do under a gradual application of the fire: therefore, at equal temperature, the slow application of caloric produces more shrinking than a rapid action of it.

There are even circumstances in which the sudden action of caloric occasions so abundant a disengagement of gas, that, instead of effecting a shrinking, it produces a very marked intumescence.

The

The shrinking is therefore susceptible of augmentation or diminution, according as the caloric has been applied for a longer or a shorter space of time, in a more or a less rapid manner.

It results therefore conjointly from the intensity, the duration, and the mode of application of the caloric.

It is therefore not caused *solely* by the intensity of this fluid.

2. The greater or less degree of accuracy in the formation of the small argillaceous solids, which Wedgwood terms *thermometer-pieces*, gives rise to many variations in their shrinking.

Whatever caution may be used in the preparation of these solids, there will be some, the paste of which is more or less triturated, malaxated, moistened, &c. &c.

Now, the more the differences in this preparation, the more differences there will be in its manner of comporting itself with fire.

It is evident that the paste which is triturated to the greatest possible degree must, *ceteris paribus*, shrink more in the fire than that which is coarser.

It is equally evident, that the paste which has been very much malaxated, very much compressed, and employed with the least possible quantity of water, will shrink less than that which has been less used, less moistened, and less kneaded together.

Finally, it is evident that that which has been rapidly dried will not have acquired that degree of shrinking which is produced by a gradual desiccation; it will present itself to the action of the caloric full of perosities, from which it would have been exempt if it had been reduced to dryness by proper degrees; it will shrink in a more sensible degree, and consequently it will indicate so much the higher a temperature.

I pass over in silence several other causes of inaccuracy, which depend upon the execution of the pyrometrical solids; those which I have just mentioned are sufficient to demonstrate that the shrinking is not produced *invariably* by the intensity of the caloric.

It remains now to be proved, that it is not *necessarily proportionate* to this cause.

3. Suppose an aluminous mixt, of the most simple composition possible; one which contains only a single earth united with the alumine, and suppose this earth to be *silex*.

The alumine is susceptible of dilatation, by means of the liquids and of the substances more or less volatile with which it charges itself. It shrinks by the evaporation of these substances.

The silex, on the contrary, is not susceptible of any sensible dilatation or contraction.

The molecules of the latter may be considered as being enveloped by those of the first, which fix them by means of their gluten, and which nevertheless keep them more asunder, the more they themselves are kept so by the fugacious substances which divide them.

In proportion as the action of the caloric dissipates these substances, it diminishes the space which separated the molecules of the alumine; those of the silex undergo a proportionate approximation, and the shrinking of the mixt follows a more or less regular progression.

But when the contraction of this mixt has become such that the molecules of the silex come into contact, the progression of the shrinking begins to change.

And when the contact between the molecules of the silex has become complete, the shrinking ceases altogether.

Further;

Further; if the action of the caloric be prolonged, the alumine continues to contract, until it can no longer embrace the silex.

In this case not only no more shrinking takes place, but there even ensues a relaxation, occasioned by the rupture of the aluminous attachments which coerced the molecules of the silex.

The mixt then becomes more or less feeble.

Hence we see not only that the shrinking is not *necessarily proportionate* to the intensity of the caloric, but even that it is not *a constant effect* of it, since, after having augmented according to a certain proportion, it may diminish and even cease altogether, although the intensity of the caloric continue to increase.

There do not even exist necessary relations in the mode of proceeding of the one and of the other.

In fact, let us suppose a second mixt, consisting of the two parts which we supposed in the first, and besides these a third part, not wholly resisting the action of temperature like the silex; but upon which its action, instead of commencing from the lowest temperature, as it does upon the alumine, commences only at a more elevated degree, as 40° or 50°.

It is evident that the shrinking of this mixt, above 40 degrees, will not follow a gradation similar to that which it followed below that degree.

Consequently, whilst the caloric proceeds in a regularly-continued gradation, the shrinking may be more or less intermittent.

Moreover, if we suppose, what is not only very possible but even very frequently the case, that that part which we supposed to be acted upon the last, instead of contracting, undergoes a species of fermentation, as do most of the substances which have a tendency to the vitreous

treous state, it is clear that an intumescence will ensue, and that, instead of proceeding in an ascending progression, the shrinking of the mixt will cease or become retrograde.

Thus, whatever may be the gradation and the continuity of temperature applied to an aluminous mixt, its shrinking is not only not necessarily graduated, or necessarily continuous, but it also does not always necessarily take place.

There is no doubt that by simplifying as much as possible the composition of this mixt, the two-fold inconvenience which results from the defect of graduation and of continuity would be diminished.

But, 1, we cannot simplify it beyond a certain point; for, besides that it does not appear capable of being reduced to a single earth, this reduction would give rise to inconveniences, of which mention shall be made hereafter *.

2. Though we had entirely removed these two defects, we should have done nothing towards attaining the end proposed.

In fact, of what consequence is it to the solution of the problem, that the shrinking be *graduated* and *continuous*.

From the moment that it is not solely the effect of the temperature, it cannot indicate it with rigorous accuracy.

Now, from what has preceded, it is evident that this phenomenon may be modified by several simultaneous circumstances.

An instrument which indicates only the degrees of shrinking, indicates therefore the result of several causes; a result which is not subjected to any proportion with these different causes.

* See page 153.

The

The pyrometer, therefore, does not indicate solely and invariably the cause which it ought to indicate, namely, the *intensity of the caloric.*

For the sake of greater perspicuity, I have supposed the mixts to be of the most simple kind. It is evident, that the more complicated they are, the more power the causes of inaccuracy, resulting from the chemical composition, will acquire.

Now, the compositions hitherto employed for the pyrometrical solids, are much more complicated than those which I have supposed. They must therefore present, and in fact they do present, many inaccuracies in their indications.

Those which Wedgwood made at first "change," he says (see the Memoir above cited), "into a semivitreous contexture like porcelain;" and yet they contracted in a regular manner.

Those which he had subsequently made "never," he assures us, "assumed the slightest appearance of the semivitreous contexture *."

It will hardly be believed that the shrinking of these last follows the same gradation as that of the first.

I shall not stop to discuss this scruple, or to examine in how far the author may have succeeded in the composition of the different pastes which he successively employed †. I will even admit that he obtained some, the shrinking of which was sufficiently considerable to go through the whole extent of his scale.

But this composition was either the result of a theory, or a product of chance.

* See the note page 145.

† I could cite numerous instances of evidently false indications, which Wedgwood's pyrometers have presented, as well to different scientific men and artists, as to myself.

In

In the first case we might inquire, what was this theory, which the author does not communicate, did we not know that the data proper for establishing it existed not more in his time than they do at present.

But what proves that this composition, supposing it real, was not the effect of a well-ascertained method, is, that the author did not agree with himself when he attempted to repeat it.

In fact, it is known to all those who have successively employed his pyrometers, that those which he made after a certain period, have no more the same accuracy as those which he produced previous to it.

And what particularly proves that this system is not founded upon any invariable property of the aluminous mixts, is that all those who have attempted to form pyrometrical solids after the model of his have obtained results which not only did not agree with his, but which, like his, did not agree with one another.

It is therefore evident, that a pyrometer founded upon the shrinking of the aluminous mixts, cannot be considered as an instrument possessing a constant accuracy.

This is, however, no reason why it should be banished entirely from our laboratories. Imperfect as it is, it may still possess a degree of utility which ought not to be rejected, as long as we have nothing better of the kind.

It is one of those evidences whose depositions ought not to be admitted without a severe examination, but with the aid of which we may, however, arrive at the knowledge of some important truths.

Thus, in pointing out its imperfections, it has not been my purpose to proscribe it; only, as these imperfections appeared to me capable of being diminished, I thought it might be useful to make them known.

They

They depend upon the chemical composition of the paste, and upon its different preparations.

The chemical composition depends upon the nature of the earthy principles which constitute this paste, and upon the combination of these principles.

It is easily conceived, 1st. That the more simple it is, the more regular its shrinking will be; 2, that the more susceptible it is of shrinking, the more extensive will be the series of its indications; 3, that the slower the shrinking takes place, the more easy it will be to seize the degrees of this series.

These different advantages cannot be obtained beyond a certain point, because by too much diminishing the proportion of the earths which break the excessive aggregation of the molecules of the alumine, we incur the very serious inconvenience that the paste warps, and the pyrometrical solids thereby lose the regularity of their form.

There is therefore a *medium*, from which we cannot deviate without inconvenience.

Now what is this medium? What earthy compositions are they that present the slowest, the most extensive and the most regular shrinking, without losing the regularity of their form? This is a point with respect to which we are still completely ignorant.

I call preparations, 1, the division of the molecules resulting from trituration and lamination; 2, the fermentation, or what is called rotting; 3, the mode of desiccation; 4, finally all the circumstances which belong to the manual labour.

The slightest differences in these processes, as well as in the chemical compositions, occasion very great ones in the degrees of shrinking; consequently, besides the varieties resulting from the mode of application of the ca-

 loric,

loric, the aptitude which the aluminous mixtures have, in a greater degree, to contract themselves, is exposed to almost incalculable modifications.

Therefore, although this aptitude be a *general property*, it is far from being capable of presenting *general results.*

The form of the pyrometrical solids cannot be a matter of indifference; that which secures the greatest accuracy in the execution ought to be preferred.

Hitherto the shrinking has been measured only in the direction of the breadth of the pyrometrical solids; by making them of the same breadth and length, we should be enabled, with the same scale, to measure both dimensions, which would establish a kind of counterpoise.

Perhaps the construction of the scale adopted by Wedgwood, is not the best calculated for measuring elongated solids, which are more or less susceptible of warping. If they have become never so little curved in their length, they may, without having increased, nay even after having diminished, in volume, slide between the rules with more difficulty than previous to having undergone the action of the coloric, and stop below the point at which they must have arrived if they had remained straight. Thus they indicate a temperature lower than that to which they have really been exposed.

I shall not pursue these observations any farther. I think I have sufficiently shewn that the use of the pyrometer requires the greatest circumspection, and that those who shall undertake to correct it cannot expect to succeed without much knowledge and attention.

I shall conclude with an assertion which indeed is not very encouraging, but which nevertheless it is necessary to make known; namely, that independently of the radically erroneous theory upon which the pyrometer

rests,

rests, any utility of which it may become susceptible depends upon means, most of which remain still to be discovered.

In fact, the properties of the aluminous mixts result from combinations founded upon the respective affinities of the simple earths, affinities which are put in action by such or such a temperature.

Now, neither these affinities, nor the temperatures which call them into action, are as yet known to us.

Besides, the phenomena, which the impression of the caloric produces upon these mixts, present nothing absolute; they are purely relative, not merely to the affinities, not merely to the combinations, not merely to the temperatures, but also to circumstances so varied and complicated in their nature, that the most attentive and most enlightened observer cannot expect to discover and unfold them all.

These phenomena, therefore, cannot, in the present state of our knowledge, become the foundation of a system of observations subjected to calculation, and the deductions which may be drawn from them are to be considered as mere surmises.

Observations on the Rectification of Nitric Acid.

By M. STEINACHER.

From the JOURNAL DE CHIMIE.

IT has long been known that the first portions of nitric acid distilled in litharge contain muriatic acid. Berthollet explains this phenomenon by saying, that, the oxyd of lead dividing its action between the two acids, both are subject to the action of the expansibility produced by heat. Messrs. Welter and Bonjour assert, that, by em-

ploying muriate of silver, oxygenated muriatic acid is formed, and rises with the first portions. If I may be permitted to give the results of my experiments after so many able chemists, I should say, that when the nitric acid has been sufficiently concentrated before it is submitted to rectification on silver or oxyd of lead, the first portion of the rectification subjected to the test, contains no muriatic acid, notwithstanding the nitric acid contains much of the former after its concentration; and I should conclude from this fact, that the excess of water is the true cause that diminishes the attraction of the muriatic acid for the oxyds of lead or silver. It, would however, be vain to expect success in concentrating the acid before it is rectified, by taking a certain quantity of litharge, or by distilling to dryness, as many authors have prescribed. The quantity of litharge ought to vary from $\frac{1}{16}$ to $\frac{2}{16}$ of the weight of the acid, according to its degree of impurity. On the other hand, by distilling to dryness, the last portions of nitric acid hold in solution muriate of lead or of silver. I hope the following process, the progress of which is both sure and regular, may be useful to those who wish to prepare themselves the reagents with which they operate.

Four kilogrammes of nitric acid, at 35 degrees, containing muriatic acid, and a very small quantity of sulphuric acid, must first be distilled in a reverberating furnace, in a retort placed in an earthen capsule full of sand. The fire must be managed in such a manner that the drops may slowly succeed each other, and the produce be equal to half the acid. It will mark 15 degrees on Beaumé's areometer. Empty into a pitcher what is left in the retort: its weight is expressed by 40 degrees of the areometer. Throw into it litharge in the form of fine powder, and stir it with a glass stick. A few hours are sufficient

ficient to convert it into a white powder. Put in more, and keep adding further quantities, till you see that it preserves its colour after being immersed several hours. Then let the muriate and sulphate of lead entirely settle, and decant the acid into a retort of tubulated glass, set on a small earthen dish filled with sand, in the middle of a reverberating furnace, all the parts of which are preserved excepting the dome. Adapt to it a bulb that fits exactly without being luted (for as the vapour of the acid easily destroys every kind of luting, the produce would be liable to be dirty) and conduct the distillation in such a manner that there may be a short interval between the falling of each drop. Care must be taken to keep the acid in ebullition, as it would otherwise disperse in vapours that could not be forced over. The first half marks 35 degrees and the second 40. Both portions are colourless and possess all the properties of very pure nitric acid, provided the precaution be observed to leave $\frac{1}{32}$ of the liquid in the retort.

If you suspend the distillation after separating the first portion, you obtain, when the retort becomes cold, a beautiful crystallization of muriate of lead in large hexëadral flakes, striated and very brilliant. This salt is a real muriate, for sulphuric acid disengages from it vapours easily distinguished to be those of muriatic acid. By continuing the distillation, these crystals by degrees lose their regular figure, and are at length precipitated at the bottom of the liquid in the form of a powder.

Intelligence

Intelligence relating to Arts, Manufactures, &c.

(Authentic Communications for this Department of our Work will be thankfully received.)

Felloplastik.

A WORK has recently been published at Gotha, intituled, "Felloplastic, or the Art of representing architectural Subjects in Cork," with Three Plates.

The inventor of this art, though of thirty years standing, is unknown. The work is anonymous, but the author informs us, that M. May, who about sixteen years since made the tour of Italy, conceived a violent passion for this art, which he brought to a high degree of perfection. This genleman has executed thirty nine models of this kind, among which are several monuments of Gothic antiquity, particularly the ruins of an abbey at Paulenzell, near Schwarzburg.

List of Patents for Inventions, &c.

(Continued from Page 80.)

JOHN SLATER, of Liverpool, in the county palatine of Lancaster, Gentleman; for certain improvements upon sawing-mills, or machines for sawing all kinds of timber. Dated May 2, 1805.

MARC ISAMBARD BRUNEL, of Portsea, in the county of Hants, Gentleman; for saws and machinery, upon an improved construction, for sawing timber in an easy and expeditious manner. Dated May 7, 1805.

JOHN EDWARDS, of the parish of St. Paul Covent Garden, in the county of Middlesex, Currier and Harness-maker; for certain improvements on bridles. Dated May 7, 1805.

OBADIAH

Obadiah Elliott, of the parish of St. Mary Lambeth, in the county of Surrey, Coach-maker; for certain improvements in the construction of coaches, chariots, barouches, landaus, and various other four-wheel carriages. Dated May 11, 1805.

John Edwards, of the parish of St. Paul Covent Garden, in the county of Middlesex, Currier and Harness-maker; for a machine or apparatus upon an improved construction, for the purpose of preventing persons being drowned, which he denominates *The Life Buoy*. Dated May 11, 1805.

William Horrocks, of Stockport, in the county of Chester, Cotton-manufacturer; for farther improvements to a machine for the weaving of cotton and other goods by hand, steam, water, or other power. Dated May 14, 1805.

Charles Hobson, of Sheffield, in the county of York, Silver-plater, Charles Sysvester, of the same place, Chemist, and John Moorhouse, of Sheffield aforesaid, Surgeon; for a method of sheathing ships, roofing houses, and lining water-spouts, with a material not heretofore used for those purposes. Dated May 18, 1805.

Thomas Pidgeon, of the parish of St. Pancras, in the county of Middlesex, Gentleman; for a saddle upon an improved construction. Dated May 18, 1805.

Abraham Ogier Stransbury, of the city of New York, in the United States; for locks and keys upon an improved construction. Dated May 18, 1805.

John Bevans, of Little Queen-street, Lincoln's-Inn-Fields, in the county of Middlesex, Carpenter and Joiner; for a window-frame and sashes upon a principle wholly new, applicable to frames and sashes already made as to

new

new ones, which conceal the sash-lines and exclude the air. Dated May 27, 1805.

JOHN BLUNT, of the borough of Warwick, in the county of Warwick, Surgeon; for an improvement to stirrups now in use, which is to be fixed thereto, and by means of which, whenever the stirrup happens to be in a reversed direction, by a horseman falling from his horse, the stirrup will immediately fall from the leather, by which means the same is suspended. Dated May 27, 1805.

SAMUEL MILLER, of the parish of St. Pancras, in the county of Middlesex, Engineer; for an improvement upon, and machinery to be attached to, coaches, and various other carriages; for the better accommodation of passengers. Dated May 27, 1805.

JOHN COX STEVENS, of New York, North America, but now residing in New Bond-street, in the county of Middlesex, Gentleman; for a new method of generating steam. Dated May 31, 1805.

ALEXANDER BRODIE, of Carey-street, in the liberty of the Rolls, and county of Middlesex, Iron-master and Founder; for an improved method of making steam-engine-boilers and steam-boilers, for various other purposes; and of constructing the flue for the conveying the heat to the same, whereby the consumption of fuel is considerably lessened. Dated May 31, 1805.

THE REPERTORY OF ARTS, MANUFACTURES, AND AGRICULTURE.

No. XXXIX. SECOND SERIES. August 1805.

Specification of the Patent granted to George Alexander Bond, *of Hatton Garden, in the Parish of St. Andrew Holborn, in the County of Middlesex, Gentleman; for certain Improvements on the Construction of Clocks and other Time-Keepers, whereby they are rendered of much greater Utility and Service both by Land and Sea than any heretofore made use of.*

Dated March 26, 1805.

With a Plate.

To all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, I the said George Alexander Bond do hereby declare, that the principal objects of my invention are as follows: My method of improving the utility of clocks, watches or time-keepers in general, is by making the dial-plate on which the hours are marked, of some transparent or semi-transparent substance, so that the letters and figures, as well as the hands that point to the hour and minutes, not being transparent but opaque, and a light placed behind, the hour may be known during the night,

night, or in a dark room. I have various ways of constructing clocks, so that the wheels or mechanical part of them may not intercept the light from striking upon the back of the dial-plate so as to pass through and shew the hour.

Fig. 1 (Plate VIII.) shews the first-view of a table or spring clock, supposed to be standing on a chimney-piece. In this clock the dial-plate is advanced so far before the wheels or movement-part, by means of the axles on which they are fixed being long, that there may be room for placing a lamp or candle between the works and the dial-plate so that the light may go through without interruption.

A, is the dial-plate.

B, the box in which are the movements.

C, The long axle, on which are fixed the handles or hands.

D, the candle, candles, or lamp, double or single.

Fig. 2 is a side-view of a clock of the same nature and use, but differently constructed; in which the works or movement are so much smaller than the dial-plate that the hours and minutes, and the two hands that point to them, can be seen beyond the case in which they are contained, as represented by Fig. 3, which is the front-view of a dial-plate, with a small movement of the sort represented in Fig. 2. The part stained of a pale red * is supposed to be penetrated by the light. The dark part in the middle is covered by the movement.

Fig. 4 is another manner in which the movement or wheels, in the box D, may be placed either above or below, or at one side of the dial-plate, so that the light may shine through the handles, being turned by the

* Represented in the engraving by being engraved of a light tint.

axles,

axles A and B at right angles to each other, the same as if the movements were directly behind the dial-plate.

Fig. 5 is a view of a double lamp or candlestick, which I recommend the use of in Fig. 1; that the light may not be either immediately under or on side only of the axis on which are the hands.

These clocks are intended to be covered with a case, to prevent the light spreading over the apartment, provided the lamp or candle is behind the dial-plate.

Time-keepers of this sort may be so constructed as to be placed or fixed in a window-shutter or in a door, or over a door, or, in one word, in any situation to tell the hour in a dark apartment, the light being behind, whether candle-light, lamp-light, or day-light, my general principle being the transparency, or degree of transparency, in the dial-plate necessary for shewing the hour by the light shining through.

This improvement on the utility of clocks, by which they will shew the hour by night as well as by day, is applicable to clocks of steeples belonging to churches or other public buildings, as well as to table clocks or eight-day house clocks, whether they go with a spring or weights, or with a pendulum or balance wheel, or whether in great or in small.

The substances of which I make my dial-plates are glass of all sorts, clear or coloured, ground or unground, enamel, China, or porcelain, talc, horn, paper, silk, marble, ivory, or alabaster, or, as before said, of any substance transparent or demi-transparent, so as to let sufficient light pass through to shew the hour; so that, provided it has that quality, the substance is not material.

Besides the transparent dial-plates above specified, made of glass, or other substances that admit a passage

for the light, I also have a new method of making or manufacturing enamelled dials for clocks and watches, by which the polish and smoothness of surface, and general appearance is highly improved in the following manner: for whereas dials or dial-plates, as they are called, are made of enamel on a plate of metal, by melting or fusion, so that they adhere to the plate, covering it with a thin coat of enamel, too thin to admit of being ground and polished, besides being liable to crack in process of time by the constant expansion and contraction of two thin substances, the one of metal and the other of vitrifaction, so closely united and unequally operated upon by heat and cold.

To remedy both those evils I make my enameled plate a sheet of enamel or glass by itself, not upon any metallic plate, and sufficient thickness to admit of grinding and polishing perfectly smooth and flat, like as mirrors and looking-glass plates are polished, or as convex or concave optical glasses are ground and polished, so that the surface, instead of having those little roughnesses or that deviation from perfect form that all vitrifactions are more or less liable to when the outward surface remains, become mathematically true in point of form, and smooth in point of surface. My plates of enamel or glass being so made and polished, are then fixed on metal plates by means of gum or cement, or any glutinous substance such as takes hold of the impenetrable and smooth surfaces of glass and metal; or by means of setting them by turning over the edge of the metal, as in jewellery, and thereby fixing them together, so as to keep them perfectly in place and connected, but yet not quite so closely as by the mode now practised, where the enamel is fluxed or melted on the metallic plate, which, as has already been described, occasions injury by expansion; also dial-

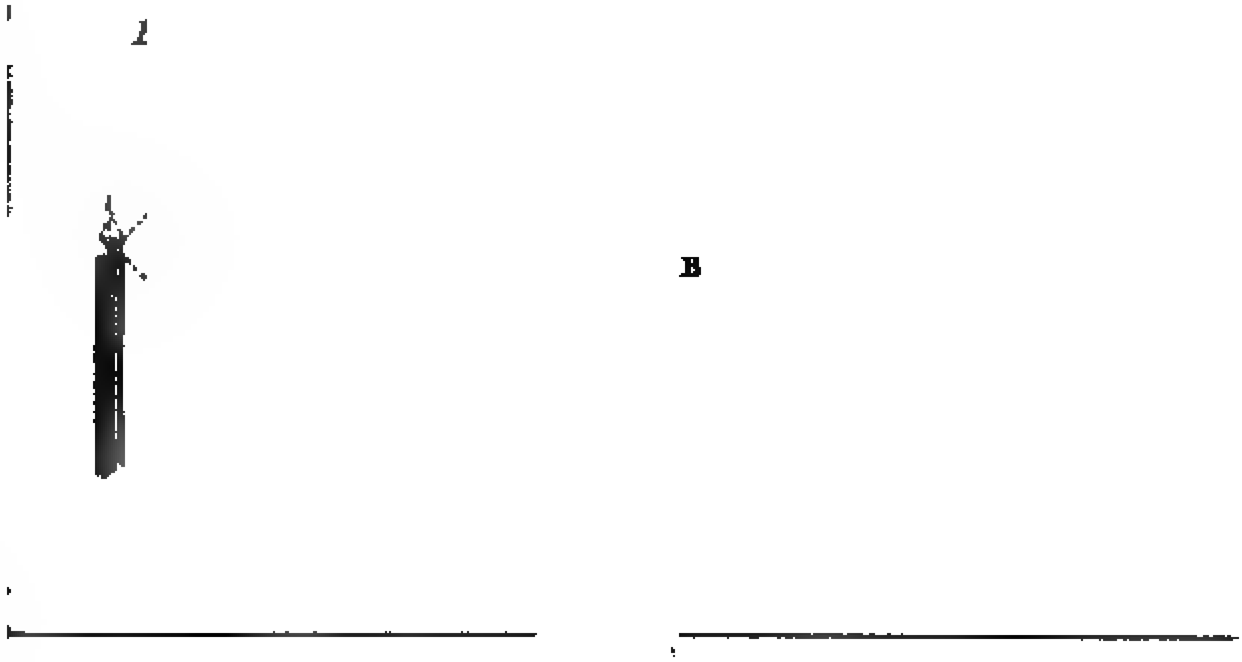


Fig. 3.

dial-plates for wheel barometers, watch or pocket compasses, &c. done in the same manner.

My invention in this latter case is not tending to dials or dial-plates of clocks and watches cheaper or more easily manufactured, but to make them more perfect in their form and polish where fine work is wanted; as in the other case my improvement has the effect of rendering those useful machines still more serviceable than heretofore, by making them tell the time with equal facility and exactness by night as they now do by day.

In witness whereof, &c.

Specification of the Patent granted to CHARLES FREDERIC MOLLERSTEN, *of Hackney Wick, in the County of Middlesex, Gentleman; for a Chemical Composition and Method of applying the same in the Preparation of Hides, Skins, and Leather, Silks, Taffetas, and Linen, and to all Articles already made of Skins and Leather, thereby colouring and giving a beautiful Gloss to the same, rendering them Water-proof, and impenetrable to hot or corroding Liquids, and at the same time preserving them from Decay, and keeping them soft and pliable.*

Dated January 23, 1805.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said Charles Frederic Mollersten do hereby describe and ascertain the nature of my said invention, and in what manner the same is to be performed, as follows; that is to say: To prepare the composition for the black colour, take two gallons of linseed oil, one gallon of whale oil, and one half pound of horse grease, mingle them with four pounds of fine ground Prussia blue and four

four pounds of lamp-black, and afterwards boil them on a strong fire; to which add one pound of fine ground benzoin gum, previously well mingled in one gallon of linseed oil, of which one half gallon is put in the above when the composition has boiled one half hour, and the residue when it is sufficiently boiled and ready. This composition is quite boiled enough when it gets so thick that no drops fall from any thing dipped into it; and it is afterwards fit for use when cold. For all other colours the genuine linseed oil must be well bleached; to two gallons of which put one half gallon of spermaceti oil and one half pound of Prussia blue; place them in a glass vessel in a strong sun, (the effect encrease by burning glasses if necessary,) and when they have attained the same consistency as the black composition, after having boiled one half hour, take one pound benzoin gum, mixed with one gallon of linseed oil bleached, and add one-half of it to them, and place the same in the sun, as before, when it has attained the same consistency as the black composition. When ready add the remaining half of the gum and oil. The colours used, are those composed of metallic and animal parts, or metallic only, as I am not satisfied that colours composed of animal parts only will answer the purpose. Those colours which will admit an equal quantity of Prussia blue with that used in the black composition, will have an equal power of resisting heat or corroding liquids, without which their effect, as to those purposes, will not be so powerful, though equally so as to rendering water-proof the articles manufactured. The mode of working the leather, and the necessary implements for that purpose, are as follow: for leather, after having been first well curried, especially that in its brown state, well draw it out with pincers, and nail it on a board to fit the oven; which board first

cover-

cover with woollen blankets, and then lay the composition on the outside of the leather as thin as possible, by using iron scrapers of all dimensions, but at least of four inches breadth and six inches height. Every time the composition is so laid on the leather, put the board into the oven to dry the composition; and when it is taken out of the oven dry, and previous to the composition being again put on, the leather must be well rubbed with pumice stone, to smooth it more, and make the composition fasten on better. When this is done, until the leather possesses its regular gloss all over, it is (when taken out of the oven dry the last time) to be speedily taken loose from the board, and when cold is ready for use. If the leather be good, and of a smooth surface, it requires only to be done four, but if otherwise five, six, or more times; the last, or two last times the composition had best be put on with the hand, to make it very thin and exact all over. The number of times the composition should be put on the leather is very uncertain, as it depends entirely on its more or less fatness, thickness, or good quality. The same rule exists for the time it requires to dry in the oven, which is in general in about an hour, except the last, or two last times, which take about two or three hours. Silk, taffetas, and linen, are done exactly in the manner above stated, but they may be nailed to a frame of any shape if required. The drying of the leather is done in an oven or furnace, which may be constructed larger or smaller, according to wish: the best shape and dimensions of it, notwithstanding, are nine feet in length, six feet in breadth, and four or five feet in height inside. Through two iron doors, in the front of the oven, as large as the opening, the boards are put in the oven on iron rails, which are placed on the two length sides; they are distant from each other about

six

six inches, and may be made to introduce from two to twelve boards into it. The fire-place is made towards one side under the oven, and the flames and smoke go under and on all sides round the oven by means of fire-proof flues, which must be so well constructed as not to admit in the oven even smoke. A slow fire must be kept during the working of the leather, not exceeding sixty degrees of heat. All boots must be done, formed, or shaped on blocks; in which manner already-made cartouch-boxes and military accoutrements must be done previous to their being put in the oven. Some woollen stuff must be put between the wood and the leather, to prevent the heat from affecting it.

In witness whereof, &c.

Specification of the Patent granted to JAMES TATE, *of Tottenham Court Road, in the Parish of St. Pancras, in the County of Middlesex, Ironmonger; for an Improvement to be added to, or used in, the Construction of Wheel Carriages.* Dated June 26, 1802.

With a Plate.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said James Tate do hereby, and by the plans or drawings in the margin of these presents, describe and ascertain the nature and properties of my said invention, to be added to, or used in, the construction of wheel carriages, and in what manner the same is to be performed; that is to say: The nature and properties of my said invention, which I call the Union Patent Axles, have united those principles and qualities which are necessary to form a complete wheel carriage, namely, that of reducing animal

animal labour, or to be used in aid of any other power which can be applied or used for drawing or impelling wheel carriages of any description, and for holding and retaining whatever quantity of oil may be necessary to be put in for the preservation of the parts in motion, as by the particular construction and disposition of the several parts every essential movement of my said improvements have either their respective bearing in upright sockets or cups of oil, or are put in contact with upright cisterns of oil, so that the moving parts are continually moistened with it. These sockets, or the sockets or cisterns, may be made to hold any determinate quantity of oil, and thereby prevent the trouble and inconvenience of frequent oiling, or of the parts damaging for want of oil. And this reduction of animal labour, and assistance given to any other power that can be applied or used to draw in, or impel wheel carriages, I perform principally by the application and use of new or improved friction wheels, constructed for this purpose; and partly or partially by the application of other friction wheels with horizontal axles or naves, placed in new and advantageous situations, by which I transfer the friction from the nave, centre, or box of the wheel principally to the axle of the new or improved friction wheels; which, by their peculiar construction for this purpose, admit of their axles being placed in a vertical direction, thereby admitting the whole weight of the carriage, and almost the whole of the friction, to descend to or upon as many vertical points or centres as there are wheels to the carriage; which vertical points or centres of the new or improved friction wheels become the principal centre of motion as well as gravity, as more particularly described hereby, and by reference to the plan or drawings in the margin hereof; that is to say:

 Fig.

Fig. 1 (Plate XI.) is a perspective-view of one of the said new or improved friction wheels, one end of the axis at A being a centre, and the other end at B a cup or socket to receive another centre.

Fig. 2 is a longitudinal section of one of the large axles of the carriage, and of the frame K that sustains the carriage by springs or otherwise, and to which the perch or other matter is fixed to connect the hind and fore wheels together, and also the section of the two new or improved friction wheels, bearing upon shoulders of the axle made to receive them. C C, are the arms of the axle to receive the nave of the large wheels, which may be fitted together as a common wheel and axle, so that the wheel turns round upon it. But it is not absolutely essential to my said invention that the wheel should turn round on the axle, because, when my improvements are at liberty to perform their functions, the large wheels and the axles turn round together. D D are sections of the new or improved friction wheels with their axles, shewing the cups or sockets in which the casters run. These cups or sockets upwards are made larger than their centres, to hold any determinate quantity of oil. The centre of the new or improved friction wheel at B, Fig. 1, may also be made a centre, and the socket to receive it turned downwards, but then the opportunity of the centre turning in oil would be lost. E E are screws through the frame of the friction wheels, which form the whole or a part of the upper centres by which the new or improved friction wheels are regulated, and kept tight and steady in their frames.

Fig. 3 is a transverse section of the large axle and of the frame K, which sustains the carriage by springs or otherwise; and also a view of the other friction wheels with horizontal naves or axles; and of the new or improved

proved friction wheels, with the frame as it connects the whole together round the large axle. F the large axle. G G the friction wheels, with horizontal naves of axles. H the new or improved friction wheels. I I I the frame that connects the whole together round the large axle. The friction wheels G G are also regulated and kept tight and steady to their bearing upon the large axle by screws through the frame to press their axles forward. All the friction wheels together, as they appear in Fig. 3, I cover with a box or case, to prevent the access of dust or dirt; and this case or box contains a cistern, or part of the box or case itself forms a cistern, to hold oil for the use of the friction wheels G G, whose rims are made to turn round in it.

When a carriage is constructed agreeably to the principles here laid down (or where these improvements are added to an old carriage), it is evident the whole weight is sustained by the vertical axles of the new or improved friction wheels, and likewise all the friction produced by the weight of the carriage and load upon it; and that the hindmost of the lesser friction wheels G sustains only that part of the friction produced by the draught which bears various proportion to the weight, according to the plane the carriage moves on; and that the foremost of the friction wheels G sustains hardly any friction, but serves to keep the large axle in its proper position, so that the whole weight, and nine-tenths of the friction, more or less, does absolutely fall and turn upon the said vertical centres, and this causes the carriage to move with so little power that in many situations, and especially in going down hills, it would be adviseable to have a power of retarding its motion; and for this and other purposes it will be convenient and proper that the large wheels should be fitted to turn

upon the arm of the axle, as they usually have done; and then, by letting a stop fall down upon the large axle, to prevent its turning, all my improvements are suspended, and the carriage moves on with its usual impediment of friction till the stop is again taken off the axle; by this means also the advantage acquired by the use of my invention may be most accurately ascertained. When I made the experiment with a cart and load, which weighed nine hundred weight upon a plane, and with a weight over a pulley, when the large axle was at liberty to turn round, three pounds weight drew the cart along; and when the stop was let down on the axle, it required twelve pounds weight to draw it.

As circumstances require, I might find it necessary to construct all the friction wheels upon the plan and principle of my new or improved friction wheel, and sometimes it might be necessary to dispense with the friction wheels G G, and use a staple in their place; and again I might find it necessary to place a friction wheel like G on the top of the axle, in aid of the other, to sustain a great weight, and so vary and interchange them according to the purposes the carriages might be made to answer, or the price given.

All the different parts of my said invention, as herein described, I make, or cause to be, of such materials as are in general used for such like implements and purposes, so that there are no particular materials absolutely essential to my said invention.

In witness whereof, &c.

Specification

Specification of the Patent granted to John Cox Stevens, *of New York, in North America, but now residing in New Bond-street, in the County of Middlesex, Gentleman; for a Method of generating Steam. Invented and communicated to him by his Father.*

Dated May 31, 1805.

To all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, in the said letters patent contained, I the said John Cox Stevens do hereby declare that the invention is fully described and ascertained in manner following; that is to say: From a series of experiments made in France in 1790, by M. Belancour, under the auspices of the Royal Academy of Sciences, it has been found that, within a certain range, the elasticity of steam is nearly doubled by every addition of temperature equal to 30 degrees of Fahrenheit's thermometer. These experiments were carried no higher than 280 degrees; at which temperature the elasticity of steam was found equal to about four times the pressure of the atmosphere. By experiments which have lately been made by my father, the elasticity of steam, at the temperature of boiling oil, which has been estimated at about 600 degrees, was found equal to upwards of forty times the pressure of the atmosphere. To the discovery of this principle or law which obtains when water assumes a state of vapour, I certainly can lay no claim; but to the application of it, upon certain principles, to the improvement of the steam-engine I do claim exclusive right. It is obvious, that to derive advantages from an application of this principle, it is absolutely necessary that the vessel or vessels for generating steam should have strength sufficient to withstand the great pressure arising

from

from an increase of elasticity in the steam. But this pressure is increased or diminished in proportion to the capacity of the containing vessel. The principle then of this invention consists in forming a boiler by means of a system or combination of a number of small vessels, instead of using, as in the usual mode, one large one; the relative strength of the materials of which these vessels are composed increasing in proportion to the diminution of capacity. It will readily occur that there are an infinite variety of possible modes of effecting such combinations; but, from the nature of the case, there are certain limits beyond which it becomes impractible to carry our improvements. In the boiler I am about to describe, I apprehend that the improvement is carried to the utmost extent of which the principle is capable.

Description. Suppose a plate of brass, of one foot square, in which a number of holes are perforated; into each of which is fixed one end of a copper tube, of about an inch diameter, and two feet long, and the other end of the tube inserted in like manner into a similar piece of brass. The tubes, to insure their tightness, to be cast in the plates. These plates are to be inclosed at each end of the pipes by a strong cap of cast-iron or brass, so as to leave a space of an inch or two between the plates or ends of the pipes and the cast-iron cap at each end. The caps at each end are to be fastened by screw-bolts passing through them into the plates. The necessary supply of water is to be injected by means of a forcing-pump into the cap at one end; and through a tube inserted into the cap at the other end the steam is to be conveyed to the cylinder of a steam-engine. The whole is then to be encircled in brick-work or masonry, in the usual manner, placed either horizontally or perpendicularly at option.

I con-

I conceive that the boiler above described embraces the most eligible mode of applying the principle before-mentioned, and that it is unnecessary to give descriptions of the variations in form and construction that may be adopted, especially as these forms may be diversified in many different modes.

In witness whereof, &c.

On the Analysis of Soils, as connected with their Improvement. By HUMPHREY DAVY, *Esq. F. R. S.*

With a Plate.

(Concluded from Page 120.)

XIII. *Mode of detecting Sulphate of Lime (Gypsum) and Phosphate of Lime in Soils.*

SHOULD sulphate or phosphate of lime be suspected in the entire soil, the detection of them requires a particular process upon it. A given weight of it, for instance four hundred grains, must be heated red for half an hour in a crucible, mixed with one-third of powdered charcoal. The mixture must be boiled for a quarter of an hour, in a half pint of water, and the fluid collected through the filter, and exposed for some days to the atmosphere in an open vessel. If any soluble quantity of sulphate of lime (gypsum) existed in the soil, a white precipitate will gradually form in the fluid, and the weight of it will indicate the proportion.

Phosphate of lime, if any exist, may be separated from the soil after the process for gypsum. Muriatic acid must be digested upon the soil, in quantity more than sufficient to saturate the soluble earths; the solution must be evaporated, and water poured upon the solid matter.

matter. This fluid will dissolve the compounds of earths with the muriatic acid, and leave the phosphate of lime untouched.

It would not fall within the limits assigned to this paper, to detail any processes for the detection of substances which may be accidentally mixed with the matters of soils. Manganese is now and then found in them, and compounds of the barytic earth; but these bodies appear to bear little relation to fertility or barrenness, and the search for them would make the analysis much more complicated without rendering it more useful.

XIV. *Statement of Results and Products.*

When the examination of a soil is completed, the products should be classed, and their quantities added together, and if they nearly equal the original quantity of soil, the analysis may be considered as accurate. It must, however, be noticed, that when phosphate or sulphate of lime are discovered by the independent process XIII. a correction must be made for the general process, by subtracting a sum equal to their weight from the quantity of carbonate of lime, obtained by precipitation from the muriatic acid.

In arranging the products, the form should be in the order of the experiments by which they were obtained.

Thus 400 grains of a good silicious sandy soil may be supposed to contain

	Grains.
Of water of absorption - - - - - - - - - -	18
Of loose stones and gravel principally silicious -	42
Of undecompounded vegetable fibres - - - -	10
Of fine silicious sand - - - - - - - - - - -	200
Carried forward - - -	270

Of

		Grains.
Brought forward - - - -		270
Of minutely divided matter separated by filtration, and consisting of		
Carbonate of lime - - - - - - - - - -	25	
Carbonate of magnesia - - - - - - - -	4	
Matter destructible by heat, principally vegetable - - - - - - - - - - - - - - -	10	
Silex - - - - - - - - - - - - - - -	40	
Alumine - - - - - - - - - - - - - -	32	
Oxyd of iron - - - - - - - - - - - -	4	
Soluble matter, principally sulphate of potash and vegetable extract - - - - - - -	5	
Gypsum - - - - - - - - - - - - - -	3	
Phosphate of lime - - - - - - - - - -	2	
		125
Amount of all the products - - - -		395
Loss - - - - - - - - - - - - -		5

In this instance the loss is supposed small; but in general, in actual experiments, it will be found much greater, in consequence of the difficulty of collecting the whole quantities of the different precipitates; and when it is within thirty for four hundred grains, there is no reason to suspect any want of due precision in the processes.

XV. *This general Method of Analysis may in many Cases be much simplified.*

When the experimenter is become acquainted with the use of the different instruments, the properties of the reagents, and the relations between the external and chemical qualities of soils, he will seldom find it necessary to perform, in any one case, all the processes that have been described. When his soil, for instance, contains

no notable proportion of calcareous matter, the action of the muriatic acid IX. may be omitted. In examining peat soils, he will principally have to attend to the operation by fire and air X.; and, in the analysis of chalks and loams, he will often be able to omit the experiment by sulphuric acid XI.

In the first trials that are made by persons unacquainted with chemistry, they must not expect much precision of result. Many difficulties will be met with; but in overcoming them, the most useful kind of practical knowledge will be obtained; and nothing is so instructive in experimental science, as the detection of mistakes. The correct analyst ought to be well grounded in general chemical information; but perhaps there is no better mode of gaining it than that of attempting original investigations. In pursuing his experiments, he will be continually obliged to learn from books, the history of the substances he is employing or acting upon; and his theoretical ideas will be more valuable in being connected with practical operation, and acquired for the purpose of discovery.

XVI. *On the Improvement of Soils, as connected with the Principle of their Composition.*

In cases when a barren soil is examined with a view to its improvement, it ought in all cases, if possible, to be compared with an extremely fertile soil in the same neighbourhood, and in a similar situation: the difference given by their analyses would indicate the methods of cultivation; and thus the plan of improvement would be founded upon accurate scientific principles.

If the fertile soil contained a large quantity of sand, in proportion to the barren soil, the process of amelioration would depend simply upon a supply of this substance;

stance; and the method would be equally simple with regard to soils deficient in clay or calcareous matter.

In the application of clay, sand, loam, marle, or chalk to lands, there are no particular chemical principles to be observed; but when quick lime is used, great care must be taken that it is not obtained from the magnesian limestone; for, in this case, as has been shewn by Mr. Tennant, it is exceedingly injurious to land *. The magnesian limestone may be distinguished from the common limestone by its greater hardness, and by the length of time that it requires for its solution in acids, and it may be analysed by the process for carbonate of lime and magnesia IX.

When the analytical comparison indicates an excess of vegetable matter, as the cause of sterility, it may be destroyed by much pulverization and exposure to air, by paring and burning, or the agency of lately-made quicklime. And the defect of animal and vegetable matter must be supplied by animal or vegetable manure.

XVII. *Sterile Soils in different Climates and Situations must differ in Composition.*

The general indications of fertility and barrenness, as found by chemical experiments, must necessarily differ in different climates, and under different circumstances. The power of soils to absorb moisture, a principal essential to their productiveness, ought to be much greater in warm and dry countries than in cold and moist ones; and the quantity of fine aluminous earth they contain larger. Soils likewise that are situated on declivities ought to be more absorbent than those in the same climate on plains

* Philosophical Transactions for 1799, p. 305. This limestone is found abundantly in Yorkshire, Derbyshire, and Somersetshire.

or in vallies *. The productiveness of soils must likewise be influenced by the nature of the subsoil, or the earthy or stony strata on which they rest; and this circumstance ought to be particularly attended to, in considering their chemical nature, and the system of improvement. Thus a sandy soil may sometimes owe its fertility to the power of the subsoil to retain water; and an absorbent clayey soil may occasionally be prevented from being barren, in a moist climate, by the influence of a substratum of sand or gravel.

XVIII. *Of the chemical Composition of fertile Corn Soils in this Climate.*

Those soils that are most productive of corn contain always certain proportions of aluminous and calcareous earth in a finely divided state, and a certain quantity of vegetable or animal matter.

The quantity of calcareous earth is however very various, and in some cases exceedingly small. A very fertile corn-soil from Ormiston in East Lothian afforded me, in an hundred parts, only eleven parts of mild calcareous earth; it contained twenty-five parts of silicious sand; the finely-divided clay amounted to forty-five parts. It lost nine in decomposed animal and vegetable matter, and four in water, and afforded indications of a small quantity of phosphate of lime.

This soil was of a very fine texture, and contained very few stones or vegetable fibres. It is not unlikely that its fertility was in some measure connected with the phosphate; for this substance is found in wheat, oats, and barley, and may be a part of their food.

* Kirwan, Trans. Irish Academy, vol. V. p. 175.

A soil

A soil from the low lands of Somersetshire, celebrated for producing excellent crops of wheat and beans without manure, I found to consist of one-ninth of sand, chiefly silicious, and eight-ninths of calcareous marle tinged with iron, and containing about five parts in the hundred of vegetable matter. I could not detect in it any phosphate or sulphate of lime, so that its fertility must have depended principally upon its power of attracting principles of vegetable nourishment from water and the atmosphere *.

Mr. Tillet, in some experiments made on the composition of soils at Paris, found that a soil composed of three-eighths of clay, two-eighths of river sand, and three-eighths of the parings of limestone, was very proper for wheat.

XIX. *Of the Composition of Soils proper for bulbous Roots and for Trees.*

In general, bulbous roots require a soil much more sandy and less absorbent than the grasses. A very good potatoe soil, from Varfel, in Cornwall, afforded me seven-eighths of silicious sand; and its absorbent power was so small, that one-hundred parts lost only two by drying at 400 Fahrenheit.

Plants and trees, the roots of which are fibrous and hard, and capable of penetrating deep into the earth, will vegetate to advantage in almost all common soils which are moderately dry, and which do not contain a very great excess of vegetable matter.

I found the soil taken from a field at Sheffield-place, in Sussex, remarkable for producing flourishing oaks, to

* This soil was sent to me by T. Poole, Esq. of Nether Stowey. It is near the opening of the river Parret into the British Channel; but, I am told, is never overflowed.

consist

consist of six parts of sand, and one part of clay and finely divided matter. And one hundred parts of the entire soil, submitted to analysis, produced

	Parts.
Water	3
Silex	54
Alumine	28
Carbonate of lime	3
Oxyd of iron	5
Decomposing vegetable matter	4
Loss	3

XX. *Advantages of Improvements made by changing the Composition of the earthy Parts of Soils.*

From the great difference of the causes that influence the productiveness of lands, it is obvious that in the present state of science, no present system can be devised for their improvement, independent of experiment; but there are few cases in which the labour of analytical trials will not be amply repaid by the certainty with which they denote the best methods of amelioration; and this will particularly happen when the defect of composition is found in the proportions of the primitive earths.

In supplying animal or vegetable manure, a temporary food only is provided for plants, which is in all cases exhausted by means of a certain number of crops; but when a soil is rendered of the best possible constitution and texture, with regard to its earthy parts, its fertility may be considered as permanently established. It becomes capable of attracting a very large portion of vegetable nourishment from the atmosphere, and of producing its crops with comparatively little labour and expense.

DESCRIP-

DESCRIPTION of the APPARATUS for the ANALYSIS of SOILS. (Plate IX.)

A, retort.

B B, funnels for the purpose of filtrating.

C C, *(omitted to be described.)*

D, balance.

E, Argand's lamp.

F, G, H, K, the different parts of the apparatus required for measuring the quantity of elastic fluid given out during the action of an acid on calcareous soils. F represents the bottle for containing the soil. K the bottle containing the acid, furnished with a stop-cock. G the tube connected with a flaccid bladder. I the graduated measure. H the bottle for containing the bladder. When this instrument is used, a given quantity of soil is introduced into F; K is filled with muriatic acid, diluted with an equal quantity of water; and the stop-cock being closed is connected with the upper orifice of F, which is ground to receive it. The tube G is introduced into the lower orifice of F, and the bladder connected with it placed in its flaccid state into H, which is filled with water. The graduated measure is placed under the tube of H. When the stop-cock of K is turned, the acid flows into F, and acts upon the soil; the elastic fluid generated passes through G into the bladder, and displaces a quantity of water in H equal to it in bulk, and this water flows through the tube into the graduated measure: the water in which gives by its volume the indication of the proportion of carbonic acid disengaged from the soil; for every ounce measure of which two grains of carbonate of lime may be estimated.

L, represents the stand for the lamp.

M, N, O, P, Q, R, S, represent the bottles containing the different re-agents.

An

An experimental Essay on Salt as a Manure, and as a Condiment mixed with the Food of Animals.

By the Rev. EDMUND CARTWRIGHT, *of Woburn.*

From the COMMUNICATIONS to the BOARD of AGRICULTURE.

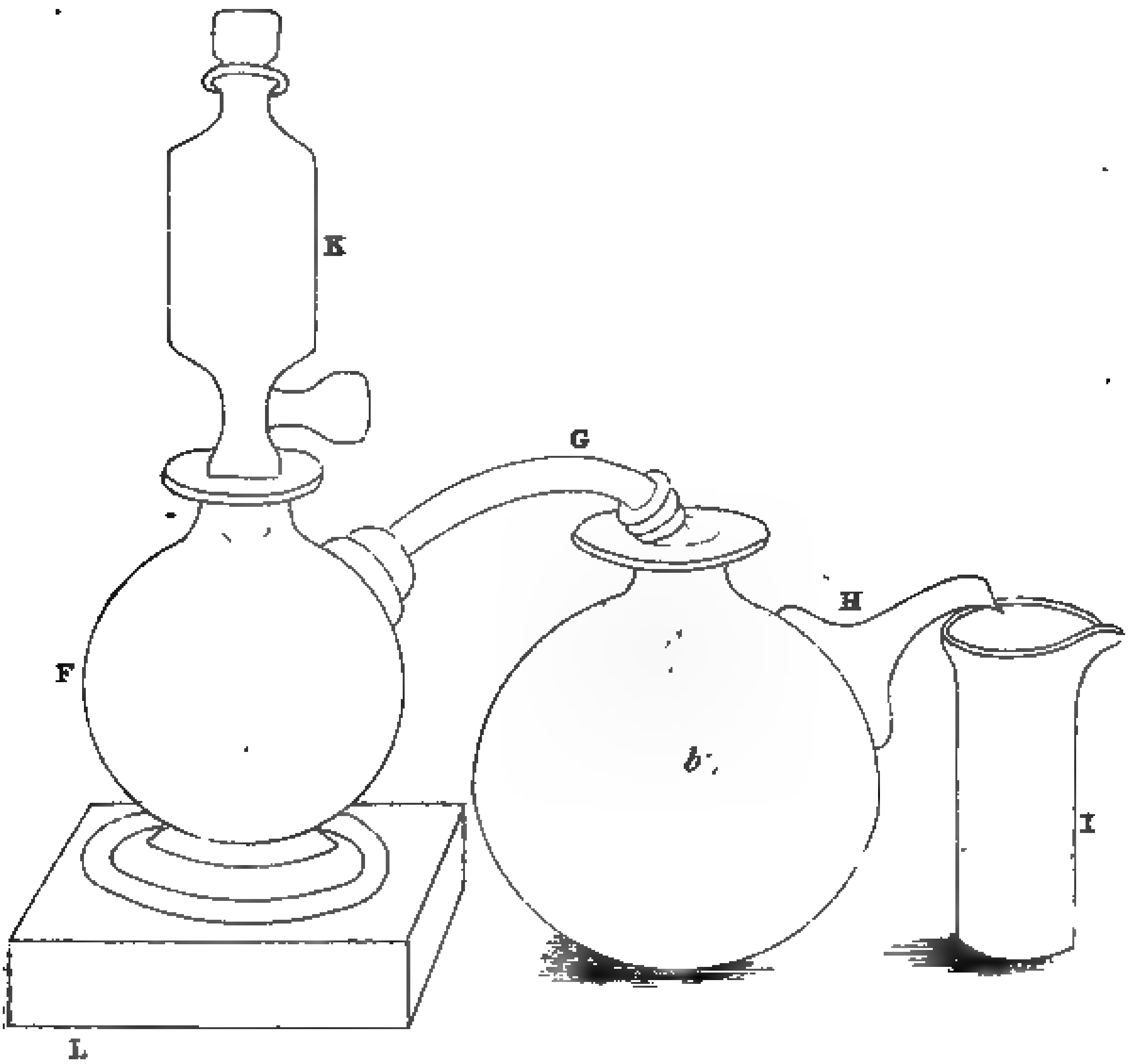
The Gold Medal was adjudged to the Author for this Essay.

WERE the beneficial effects of salt as a manure to be once fairly ascertained, there can be no doubt but the wisdom of the legislature would devise some means by which, without prejudice to the revenue, the farmer might apply it to the purposes of agriculture.

At present the use of salt as a manure is a subject on which the public opinion is much divided; its advocates, reasoning from the striking effects of salt water on the marshes, which are occasionally irrigated by the sea at spring-tides, conclude that the fertilizing virtue of such irrigation is owing to its saline quality, without taking into consideration the quantity of animal and vegetable matter which sea water (particularly near the coast, and where rivers discembogue themselves) must necessarily hold in solution.

Those who maintain a contrary opinion, considering salt merely as an antiseptic, satisfy themselves that it is impossible that any thing can be friendly to vegetation, which retards putrefaction, a process indispensible in substances that are to be the food of plants. To get over this difficulty, it has been conjectured, nay, there have not been wanting those (and of great name too) who have even attempted to prove, that salt in small quantities accelerates, as in large quantities it is known to resist, putrefaction; a doctrine to which, however, I shall not

willingly


K
G
F
H
b
I
L


C
D
H

relation as possible of the experiments I have tried, to ascertain the advantages or disadvantages which may attend the use of salt as a manure, and also when mixed with the food of animals.

It may be necessary first of all to premise, that the soil on which my experiments were tried, is a ferruginous sand, brought to a due texture and consistence by a liberal covering of pond-mud. Of this soil, in its improved state I mean, by the accession of pond-mud (for having been used merely as a nursery for raising forest trees previous to these experiments, the nursery-man had not thought it necessary to make use of any other manure), the following is the analysis:

	Grains.
400 grains gave of silicious sand of different degrees of fineness about - - - - - - -	280
Of finely divided matter, which appeared in the form of clay - - - - - - - - - - -	104
Loss in water - - - - - - - - - - - - -	16
	400

The 104 grains of finely divided matter contained of carbonate of lime - - - - - - - -	18
Of oxyd of iron - - - - - - - - - - - - -	7
Loss by incineration (most probably from vegetable decomposing matter) - - - - -	17
The remainder principally silex and alumine.	

There were no indications of either gypsum or phosphate of lime.

It will appear from the above analysis, that these experiments could not perhaps have been tried on a soil better adapted to give impartial results; for, of its component

ponent parts there is no ingredient (the oxyd of iron possibly excepted) of sufficient activity to augment or restrain the peculiar energies of the substances employed.

On the 14th of April 1804, a certain portion of this soil was laid out in beds one yard wide and forty long. Of these, twenty-five were manured (the first excepted) as follows:

No. 1. No manure.
2. Salt, $\frac{1}{4}$ peck.
3. Lime, one bushel.
4. Soot, one peck.
5. Wood-ashes, two pecks.
6. Saw-dust, three bushels.
7. Malt-dust, two pecks.
8. Peat, three bushels.
9. Decayed leaves, three bushels.
10. Fresh dung, three bushels.
11. Chandler's graves, nine pounds.
12. Salt, lime.
13. Salt, lime, sulphuric acid.
14. Salt, lime, peat.
15. Salt, lime, dung.
16. Salt, lime, gypsum, peat.
17. Salt, soot.
18. Salt, wood-ashes.
19. Salt, saw-dust.
20. Salt, malt-dust.
21. Salt, peat.
22. Salt, peat, bone-dust.
23. Salt, decayed leaves.
24. Salt, peat-ashes.
25. Salt, chandler's graves.

N. B. The quantities of each ingredient the same as when used singly.

On the same day the whole was planted with potatoes, a single row in each bed; and, that the general experiment might be conducted with all possible accuracy, each bed received the same number of sets.

On the 14th of May (a few days after the plants appeared above ground) the whole was carefully examined, and the comparative excellence of each row (as far at least as could be judged of by appearances) was as carefully registered. The best row was decidedly No. 7, malt-dust, after which they followed as under:

No. 11. Chandler's graves.
16. Salt, lime, gypsum, peat.
25. Salt, graves.
20. Salt, malt-dust.
9. Decayed leaves.
4. Soot.
2. Salt.
1. No manure.
5. Wood-ashes.
8. Peat.
13. Salt, lime, sulphuric acid.
14. Salt, lime, peat.
17. Salt, soot.
18. Salt, wood-ashes.
21. Salt, peat.
22. Salt, peat, bone-dust.
23. Salt, decayed leaves.
3. Lime.
6. Saw-dust.
10. Fresh dung.
12. Salt, lime.
15. Salt, lime, dung.
24. Salt, peat-ashes.
19. Salt, saw-dust.

On

On the 28th of May, fourteen days afterwards, the apparent vigour of the plants was the following order:

No. 7. Malt-dust.
11. Chandler's graves.
4. Soot.
8. Peat.
16. Salt, lime, gypsum, peat.
17. Salt, soot.
20. Salt, malt-dust.
21. Salt, peat.
23. Salt, decayed leaves.
25. Salt, graves.
1. No manure.
2. Salt.
5. Wood-ashes.
9. Decayed leaves.
13. Salt, lime, sulphuric acid.
14. Salt, lime, peat.
18. Salt, wood-ashes.
24. Salt, peat-ashes.
10. Fresh dung.
3. Lime.
22. Salt, peat, bone-dust.
19. Salt, saw-dust.
15. Salt, lime dung.
12. Salt, lime.
6. Saw-dust.

On the 21st of September the potatoes were taken up, when the produce of each row was in succession as follows:

No. 17. Salt and soot produced - - - - - 240
11. Chandler's graves - - - - - - - 220
18. Salt, wood-ashes - - - - - - 217

No.

No. 16.	Salt, gypsum, peat, lime - - - -	201
15.	Salt, lime, dung - - - - - - - -	199
2.	Salt - - - - - - - - - - - - - -	198
25.	Salt, graves - - - - - - - - -	195
4.	Soot - - - - - - - - - - - - - -	192
10.	Fresh dung - - - - - - - - - - -	192
20.	Salt, malt-dust - - - - - - - -	189
5.	Wood-ashes - - - - - - - - - -	187
23.	Salt, decayed leaves - - - - - -	187
24.	Salt, peat-ashes - - - - - - - -	185
7.	Malt-dust - - - - - - - - - - -	184
14.	Salt, lime, peat - - - - - - - -	183
19.	Salt, saw-dust - - - - - - - - -	180
22.	Salt, peat, bone-dust - - - - -	178
9.	Decayed leaves - - - - - - - -	175
13.	Salt, lime, sulphuric acid - - -	175
21.	Salt, peat - - - - - - - - - - -	171
12.	Salt, lime - - - - - - - - - - -	167
8.	Peat - - - - - - - - - - - - - -	159
1.	No manure - - - - - - - - - - -	157
6.	Saw-dust - - - - - - - - - - - -	155
3.	Lime - - - - - - - - - - - - - -	150

The foregoing table furnishes many particulars worthy of observation. In the first place it is remarkable, that of ten different manures, most of which are of known and acknowledged efficacy, salt, a manure hitherto of an ambiguous character, is superior to them all, one only excepted! And again, when used in combination with other substances, it is only unsuccessfully applied in union with that one, namely, chandler's graves, no other manure seemingly being injured by it. Possibly its deteriorating effects on chandler's graves may be owing to its antiseptic property, which retards the putrifacture process by which

which animal substances undergo the changes necessary to qualify them to become the food of plants. This, however, I cannot, from any appearance in the soil when the plants were taken up, assert to have been the case.

The extraordinary effects of salt, when combined with soot, are strikingly singular. There is no reason to suppose these effects were produced by any known chemical agency of soot or salt on each other. Were I to guess at the producing cause, I should conjecture it to be that property of saline substances by which they attract moisture from the atmosphere; for I observed those beds where salt had been used were visibly and palpably moister than the rest, even for weeks after the salt had been applied, and this appearance continued till rain fell, when of course the distinction ceased. This property of attracting moisture had greater influence possibly on the soot than on any of the other manures, as soot, from its acrid and dry nature, may be supposed to require a greater proportion of water to dilute it than those substances which contain water already. It may be proper to observe, that on those beds where salt had been used, the plants were obviously of a paler green than on the rest, though not less luxuriant; a circumstance which I thought worth noticing, and which I considered, though erroneously, (as appeared by the event,) to indicate a want of vigour, which would be felt in the crop. It was observable also, that where salt was applied, whether by itself, or in combination, the roots were free from that scabbiness which oftentimes infects potatoes, and from which none of the other beds (and there were in the field nearly forty more than what made part of these experiments) were altogether exempt.

Two sets of experiments, and with the same proportions of manures, were tried with turnips and buck-wheat; on

on a soil the poorest I could meet with, which produced only a dwarf heath and lichen, and which I had had pared off. The poverty of this soil will appear by the following analysis:

400 grains gave of siliceous sand - - - - - -	320
Of finely divided matter, which appeared as brown mould - - - - - - - - - - -	68
Loss in water - - - - - - - - - - - - - -	12
	400

The finely divided matter lost by incineration nearly half its weight, which shews it contained a great deal of vegetable matter. The residuum, principally a mixture of aluminous and siliceous earths, coloured red by oxyd of iron, and containing very little calcareous matter. There were no indications of either gypsum or phosphate of lime.

July 6th, 1804, the pieces set apart for each set of experiments were respectively sown with turnips and buckwheat.

On the 26th, Nos. 1, 2, 4, 5, 6, 7, 19, 20, 21, 22, 24, 25, shewed little or no marks of vegetation. The remainder were merely in the seed-leaf.

On the 16th of August four only were alive, and in rough leaf, namely,

No. 12. Salt and lime.
13. Salt, lime, and sulphuric acid.
14. Salt, lime, peat.
16. Salt, lime, gypsum, peat.

These four maintained a sickly existence till the middle of September; shortly after which they all disappeared. (N. B. The appearances of the turnips and buck-

buck-wheat were so nearly uniform, I have not thought it necessary to notice the trifling variations between them, which could not have been done without entering into a minute detail, equally tedious and uninteresting.)

Though nothing decisive can probably be drawn from these two sets of experiments respecting the advantages or disadvantages of salt as a manure, on such a soil as I have described, because other manures of acknowledged efficacy shared the same fate with the salt, yet this inference, however, may be drawn from them, (and that not an unimportant one,) namely, that a due texture and consistence in the soil as is necessary to the existence and health of vegetables, as the pabulum they are sustained by; and this appears evidently by the superiority (such as it was) of those plants where the manure contributed in any degree to improve that texture and consistence.

Adjoining to the place where these experiments were tried is a field, which fully confirms this observation. Within these few years, a great part of it was in a state of uncultivated nature, equally barren as the spot I have been speaking of; it is, however, now brought into cultivation, and into a decent state of fertility, chiefly from its texture having been improved by a thick coating of marly clay.

In trying the effects of salt, when mixed with the food of animals, I have made no experiments on sheep, as I did not apprehend that a few limited experiments would either throw new light upon a subject which has already been sufficiently discussed, as applied to those animals, or furnish the public with facts of which it is not already in possession. My experiments have, therefore, been confined to hogs and cows.

 On

On July 23d, 1804, three hogs of the same litter, about eight months old, were put up to fatten. Their respective weights were as follows:

No. 1. 44 lbs.
2. 47 lbs.
3. 40 lbs.

From the 23d of July till the 7th of August, they were fed with barley-meal, mixed up with water; during which time they consumed three bushels and a half of barley, and gained in weight as follows:

No. 1. 12 lbs.
2. 10 lbs.
3. 5 lbs.

From the 3d of August to the 21st, they had salt mixed with their food, of which they consumed one quarter of a pound *per* day. The food consumed was four bushels; they had gained upon the last weighing as under:

No. 1. 18 lbs.
2. 22 lbs.
3. 14 lbs.

From the 21st of August to the 3d of September, the salt was discontinued, in which time they eat four bushels and a half of barley-meal, and their increase of weight was,

No. 1. 24 lbs.
2. 21 lbs.
3. 21 lbs.

From the 3d of September to the 17th, they had salt as before, and their consumption of food was the same as during the last fortnight, namely, four bushels and a half of barley-meal. Their gain of weight was,

No.

No. 1, 31 lbs.
2. 19 lbs.
3. 19 lbs. They were then slaughtered.

It did not appear that the salt had any operation either in promoting thirst or stimulating their appetites, the consumption of food being nearly the same whether salted or not, neither does it appear that the salt had any influence on their fattening; perhaps the quantity allowed them was too little; and yet I should think not, as there was enough to make their whole mass of food sufficiently savory to the human taste.

In trying this experiment it will be observed, that I did not confine one parcel of hogs to salt, and another to unsalted food. This mode of trying experiments is always uncertain, as there will be frequently particular habits and tendencies in the individual animals which will vary the results, and prevent their being uniform. The fairest way, and that which is the least liable to error, is to compare each animal with himself, by feeding him at one period with one kind of food, and then, for an equal period, with another. If this principle which I have proceeded upon be right, there is nothing in these experiments to encourage the practice of administering salt to hogs with a view at least to increase their tendency to fatten; how far it may contribute to keep them in health is a different question, and on which years of experience may probably be necessary to decide. Now I am upon this subject, I shall mention (though totally foreign from the object of this essay), that most internal disorders which hogs are liable to, all of which may be supposed to be more or less accompanied with fever, I find no remedy so efficacious as antimony. This mineral is said to have obtained its name from the head of a religious house,

who had administered it with success to his hogs, giving it in such quantities to the monks of his order, as to poison them. A circumstance which probably brought it at the time into disrepute as a medicine, as well for the real as the metaphorical hogs. The anecdote, however, whether true or false, induced me some years ago to try it upon hogs; and I can safely aver that, when taken in time, there are few internal diseases which hogs are subject to that will not yield to antimony in some form or other. That form which I prefer is emetic tartar, as lying in small compass. I give it in doses from five to forty or fifty grains, according to the age and strength of my patient, and I believe still larger doses might be given with equal safety, as I do not recollect a single instance in which the animal seemed to suffer from being over-dosed.

To persons who have not tried the effects of antimony on the brute creation, the quantity I give may seem to be strangely disproportionate to the bulk of the hog, compared with that of a man; but the experience of many years has convinced me that there is no analogy (I mean as far as *quantity* is concerned) in the effects of antimony on the human constitution, and on the constitution of inferior animals.

On the 9th of October, 1804, my experiments on cows commenced. On that day two Welch heifers, one of which had calved about five months, the other three, were confined to the house, and fed with hay for the space of one fortnight. The hay they consumed during that time was four hundred weight nineteen pounds, and the milk they produced was thirty-six gallons three quarts. They had then, for the next fortnight, salt mixed with their hay, the hay being first slightly moistened

tened with water, and the salt sprinkled over it; in which time they consumed four hundred weight forty-two pounds of hay, and seven pounds of salt. The milk produced was thirty-seven gallons. For the next fortnight, namely, from the sixth to the twentieth of November, the salt was omitted, and their food was four hundred weight and one quarter of hay, and two hundred weight and a half of cabbages. The produce of milk in that space of time was fifty-four gallons three quarts. From the twentieth of November their food was the same as before, with the addition of half a pound of salt *per* day. The produce of milk was fifty-seven gallons one quart.

It will be recollected, that salt seemed to have no tendency to promote thirst, or to increase appetite in the hogs; yet on the cows its effects in one respect were very perceptible, for during the period they had salt they drank three gallons a day each more than at other times.

Salt may possibly promote digestion (notwithstanding its antiseptic quality) by stimulating the salival glands, and the glands yielding the gastric juice, and by inducing an increased discharge of their respective fluids, so necessary to the solubility of the different substances received into the stomach before they can be admitted into the lacteals.

Though there may be nothing in the foregoing experiments to lead us to suppose that salt has any otherwise a tendency to promote a disposition in animals to fatten than as it may contribute to their health, by aiding their digestion; yet it is probable that, when administered to animals yielding milk, it may contribute in some small degree to increase that secretion; and this it may do by

promoting

promoting thirst, which induces the animal to drink copiously, in consequence of which the secretion of milk, as well as all other secretions of the fluids, may be augmented. Perhaps also, it may have a stimulating influence on the lacteals themselves.

And yet, after all, admitting these experiments to prove that salt increases in some small degree the production of milk, when that increased quantity is balanced against the price of the salt, the dairy-man will find himself no gainer.

Though there does not seem any thing in these experiments, either with hogs or cows, to encourage the practice of giving salt to animals with a view to increase their disposition to fatten, yet it would be temerity to affirm that it is entirely useless. From the avidity with which most, if not all kinds of graminivorous animals, whether in a state of domestication or otherwise, are known to eat salt, whenever it comes in their way, it is reasonable to conclude that the propensity has not been implanted in them in vain. But from whatever cause its salutary effects may be supposed to proceed, whether (as was hinted at before) from its promoting digestion, and an increased secretion of fluids, or from any other action it may have on the animal œconomy, it must be left to an experimenter, more successful than I have been, to ascertain.

Description

Description of a Machine by which all the Thread-work in Shoe-making may be done in a standing Posture. Invented by Mr. THOMAS HOLDEN, *of Fettleworth, near Petworth, in Sussex.*

With a Plate.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

A Bounty of Fifteen Guineas was voted by the Society to Mr. HOLDEN *for this Invention.*

FROM the sitting posture used in my employment, as a shoemaker, I suffered so much in my health, and from the piles, that I thought I must either give up my business or lose my life. In this difficulty I invented this machine, got it made, and went to work with it. I found it answer to my satisfaction, and its use followed by a restoration of my health. I believe I have made eighteen hundred or two thousand pair of shoes with it, and still work on. I recommend it as the quickest way of closing all the thread-work.

My machine is fixed to the floor, a little to the left of the seat, but within reach of the hand; the work is held on with a stirrup, and suits to the place.

Certificates from John Summersell, cordwainer, and overseer of the parish; Richard Hawkins, John Tilly, and George Hawkins, Thomas Tilly, and Edward Hawkins, cordwainers, confirmed the above statement; as well as the following letter from Mr. Peter Martin, Surgeon, at Pulborough.

"I am sincerely of opinion, that Thomas Holden's invention is a desirable acquisition to men of that profession,

sion, especially to those who may be diseased internally, or who may suffer from stomach weakness and indigestion. These diseases may be aggravated, if not occasioned, by their working in a bent posture.

The inventor, about twenty years ago, often applied to me for relief from a train of bowel complaints, and frequently had occasion to take the medicines usually employed for the relief of dyspepsia.

I repeatedly informed him, that his employment was the cause of his disorder, and desired him to relinquish it, or invent some method to do his work standing. This hint, and his corporeal sufferings, prompted him to the invention. That it answers the purpose, I have reason to believe, as he and others use it. He is now free of complaints, and so improved in his corpulence and countenance, that he is not like the same man, and for years has had no occasion for medicine."

Reference to Plate X.

A, the bed for the closing-block, and to lay the shoe in, whilst sewing.

B, the closing-block.

C, a loose bed to lay the shoe in whilst stitching; the lower part of which is here exhibited reversed, to show how it is placed in the other bed A.

D, the hollow or upper part of the loose bed C, in which the shoe is laid whilst stitching.

E, a table on which the tools wanted are to be laid.

F, an iron semi-circle, fixed to each end of the bed A, to allow the bed to be raised or depressed. This half circle moves in the block G.

H, another iron semi-circle, with notches, which catch upon a tooth in the centre of the block, to hold the bed in

in any angle required. This semi-circle moves sidewise on two hooks in staples at each end of the bed.

I, the tail or stem of the bed A, moving in a cylindrical hole in the pillar, enabling the bed to be turned in any required direction, and which, with the movement F, enables the operator to place the shoe in any position necessary.

K, the pillar, formed like the pillar of a claw-table, excepting the two side legs being in a direct line, and the other leg at a right-angle with them.

L, the semi-circle H, shewn separately, to explain how it is connected with the staples, and how the notches are formed.

M, the tail or stem of the bed A, and the lower part of the bed N, shewn separately, to explain how the upper part of the bed is raised or depressed occasionally.

A Comparison of the Power of the common Mill Water-wheel with that of the Engine constructed for the same Purpose by M. Francini, *in* 1668; *shewing the great Superiority of the latter. Communicated by Mr.* J. W. Boswell, *in a Letter to the Editors.*

With an Engraving.

Gentlemen,

As every thing relative to the improvement of mills must be of particular importance to this country, I hope the following comparison of M. Francini's method of making a fall of water act on them, with that in common use, will be acceptable to your readers. I have had the outlines of it lying by me for some time, but other business has prevented my before compleating it.

 One

One of the most ancient modes of raising water is by a chain of vessels passing round a wheel, which, when put in motion, causes them to ascend in succession, and discharge at its summit the water which they took up at the bottom. It seems a very obvious idea, that, by the reverse of the operation of this engine, a fall of water might be made to turn round a wheel, and thus give motion to mill-machinery; and it is probable that this might have been done at a very early period, and that accounts of its use may be found much more ancient than the most remote with which I am acquainted, which is that given in the works of Dr. Desaguliers, of an engine erected on this principle by M. Francini, in the Garden of the Library of the King of France, in the year 1668; in which a fall of water turned round a wheel by a chain of buckets; which wheel drew up water from a greater depth by a second chain of buckets, of smaller dimensions; so that in this engine both applications of the chain of buckets and wheel were used.

The following comparison of the effects of this method of making a fall of water turn a wheel, used by M. Francini, with that in common use, will shew the great superiority of M. Francini's method in point of power.

Fig. 4 (Plate XI.) represents the same wheel A B C D turned by both methods, to facilitate the comparison. A B C represents the buckets of a common mill-wheel, supposed to have the water admitted on its upper part. E and F represent small drum wheels, round which a chain of buckets pass after going round the wheel A B C D, and fall perpendicularly from E to F. The water is supposed to be admitted to them at the same level as that which turns the mill-wheel.

Take for granted, that in each method the buckets are close together in succession, so that all the water

possible

possible to be used in each was admitted, and that they are also all of the same size; and then suppose the water-wheel divided by a horizontal line passing through its centre, and that the buckets are so contrived that all the upper quarter, from B to A, will continue full of water: then the force with which the water in this division of the buckets will tend to turn the wheel will be equal to that of a column of water, of the length from A to B, and the same base as the bottom of one of the buckets, applied at that part of the horizontal radius, where a perpendicular line let fall from the centre of gravity of that division of the buckets would touch, which would be very nearly in the middle part between B and the centre; or, what is the same thing, the above would be equal to a column of water of the same base before mentioned, and half the length from B to A, applied at B. For, from the position of this division of the buckets on the wheel, the water in each would have less power to give motion to the wheel in proportion as it was nearer to A, and therefore the force of the whole to turn the wheel may be esmated as that of a triangular prism of water applied at B, of the height from A to B, whose base was equal to that of one of the buckets; which prism can be proved to be equal to the square column last mentioned, of the same base with it, and half the height; or, which comes to the same thing, the whole circular segment of buckets full of water, from A to B, will tend to turn round the wheel with a force equal to its whole weight appended to that part of the horizontal radius over which its centre of gravity lies; but as this segment stretches from over the centre, where its weight will have no effect in turning the wheel, to the point B, where the weight will have the greatest power, at a rough estimate its centre

 of

of gravity would lie very nearly over the middle of the radius before mentioned.

The lower division of buckets from B to C would lose water after passing B more and more as they approached C, till at that point they would each in turn be empty; hence the whole weight of this water might be estimated as that of a similar triangular prism or wedge to that before mentioned, appended at B, or to a square column of the same base, and half the height.

These dimensions are somewhat over the real estimate, for the buckets would be totally empty before they came to C; and, besides, the diminished quantity of water in each would operate with still less force as it approached nearer to C, on account of its being at a less distance from the perpendicular, of the centre; therefore it is evident that this estimate of the force with which the water acts to turn the mill-wheel is rather in excess than otherwise.

From what has been premised of the two segments from A to B, and from B to C, the operation of the water, in the whole space from A to C, to turn the wheel, will be equal to the weight of a column of water appended at B, of the dimensions of the two equivalents before mentioned united, which would be that of a square column of the length from A to B, and of the same base before mentioned.

Now, on the other side, it is evident, that the pressure of water in M. Francini's method would be equal to that of a square column of water, of the length of the diameter A C, and of the same base before mentioned, appended at B. For the column of water in the buckets from E to F losing nothing by leakage, the weight of the whole being applied exactly at right angles to the wheel in the

the most favourable position for effect, it is plain, from mere inspection of the figure, that the power would be as stated.

There should be some little diminution of this estimate, for loss of effect on that part of the chain of buckets which passed round the lower quarter of the drum-wheel F, as this could not be depressed much without causing the buckets to move under water; but it is plain this loss might be diminished at pleasure, by reducing the size of the lower drum-wheel. And besides, unless the buckets moved with great rapidity, their passing through water would not much impede their motion; and therefore F might be sunk so low, that nothing would be lost of the length of the column E F on this account.

Stating therefore the operation of M. Francini's method to be as a column of water of the height of the diameter A C of the wheel (that of the given fall of water), and the effect of the water on the common mill-wheel to be as a column water of the length of the segment A B, and of the same base as the other column, it is plain that Francini's is to the common method nearly as the diameter of a circle is to one-fourth the circumference, or as fourteen to eleven, in point of power, at any one time. There is, however, another circumstance to be still considered in the comparison, which will add something considerable in favour of M. Francini's method; which is, the proportional quantity of water required to produce the foregoing effect in each method.

In Francini's method the quantity required will be equal to the power produced, or to the column from E to F, or as the diameter A C. In the common method the quantity required will be double the weight of the power produced, or equal to half the circle of buckets full; therefore the quantity required for M. Francini's will be

to

to that required for the common water-wheel, to produce the proportional effect in each before mentioned, as the diameter of a circle to half its circumference, or as seven to eleven.

Therefore, considering both those circumstances together, M. Francini's method with four-elevenths less water will produce three-fourteenths more effect than the common water-wheel; the fall of the water; the size and proximity of the buckets, being the same for both methods: which will be on the whole more than one-half, or about six-elevenths, in favour of M. Francini's method; or, in other words, with the same consumption of water it will perform more than one half more work than the common water-wheel.

The chain of buckets circulating round a wheel seems to be a favourite engine with patentees: two patents have been taken out for the very ancient application of it to raise water; and lately another patent has been obtained for the other application of it, which is the subject of this paper, in conjunction with that which was the object of the other patents.

It is however not my intention here to settle patent rights, but merely to state that this very ancient contrivance, put in practice about 136 years ago by M. Francini, is a very valuable mode of giving motion to water-mills, and that it highly deserves to be fairly tried by any one who possesses a water-mill with a limited supply, whose power he wishes to increase.

I am, Gentlemen, yours, &c.

J. W. Boswell.

Observations

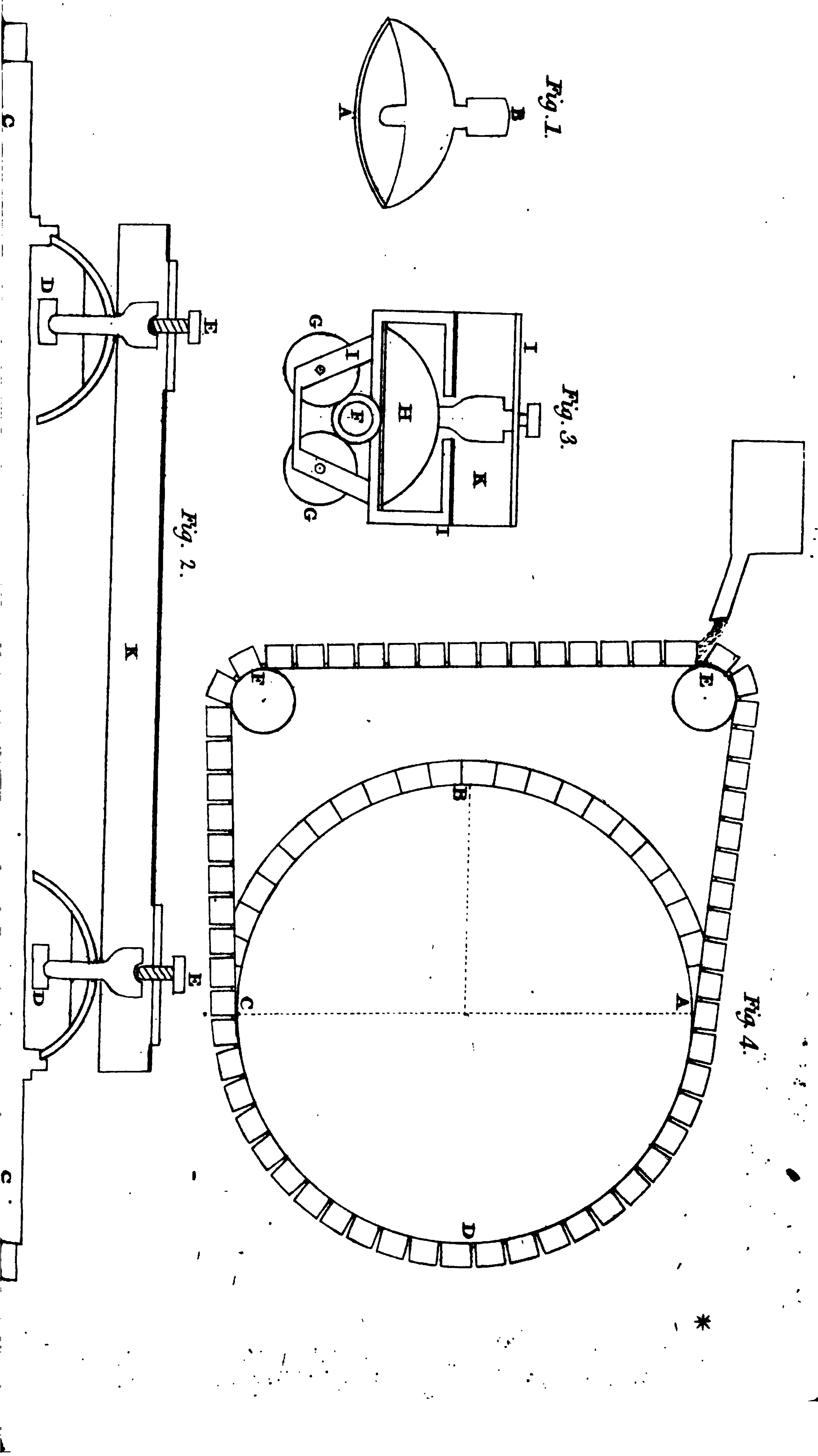


Fig. 1.
A
B
Fig. 2.
C
D
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Fig. 3.
F
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I
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Fig. 4.
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Observations on absolutely pure Nickel, proving that it is a noble Metal, and describing its preparation and peculiar Properties. By Dr. J. B. Richter.

From the Neues Journal der Chemie.

I. We can never be sure that the sulphate of nickel and ammoniae, or the triple salt which results from the combination of nickel, ammoniae, and sulphuric acid, is entirely free from cobalt, even after it has been several times crystallized, though by that operation the cobalt is reduced to a quantity extremely small. But when all traces of cobalt have disappeared, the copper opposes a new obstacle to the preparation of absolute pure nickel. I have elsewhere observed, that cobalt may be deprived of all its copper by subjecting it to sublimation with muriate of ammoniac; but at that time I had not obtained regulus of nickel in a state of absolute purity, as is demonstrated in the following experiments. In the absolute purification, you invariably observe that more or less copper is separated from it; whence it may be concluded, that the sublimation with muriate of ammoniac has not expelled all the copper of the cobalt contained by the nickel, though the volatilized muriate of ammoniac exhibits no traces of copper. This triple salt likewise contains some arsenic; it is possible that there may also be some iron, especially if the operator has been desirous of economising the nitre mixed with the sulphuric acid to dissolve the ore of cobalt which contains the nickel when exposed to the fire.

II. All my endeavours completely to purify this metal by humid means proved ineffectual. In this manner I decomposed with carbonate of potash the triple salt which

was

was freed from iron, and contained only an imperceptible quantity of cobalt, and that I might save the oxyd of nickel, I did not put an excess of carbonate of potash. The precipitate had during the whole time a greenish-blue colour; I washed, dried, and exposed it to the action of the fire. During the latter operation it changed colour, because it lost its carbonic acid; from green it turned to a blackish-grey, still however retaining a greenish cast. That I might not lose any of the metal in the water in which it had been levigated, which was of a green colour and transparent, I evaporated it to dryness: I put the greenish residue on the fire, and made it boil several times, with water, to which no colour was communicated. The residue was almost entirely composed of carbonate of nickel, under the form of a green powder, which, on being again exposed to the fire, did not lose its colour.

III. I mixed these two kinds of oxyd of nickel each with the fiftieth part of its weight of charcoal, and exposed them for eighteen hours to the fire of a porcelain-furnace, in an assaying crucible, which was covered with a small quantity of porcelain enamel. The products of this operation were somewhat different; both bore the strokes of a hammer without breaking, but the globule proceeding from the green oxyd, made by exposing to the fire the salt still containing nickel, was whiter and more brittle than that resulting from the oxyd produced by the precipitation of the triple salt with potash. The latter was likewise distinguished by its colour, which nearly resembled that of steel, and which was a little inclined to red. Both quickly dissolve in nitric acid, and are attracted by the load-stone, but the white and brittle globule possessed that property in an inferior degree.

IV.

IV. Various phenomena which I had observed in porcelain *, had almost convinced me that nickel is a perfect metal, whose oxyd may be reduced to any required temperature, without the addition of any combustible substance.

With pure nitric acid I dissolved all the metal of nickel which I had just made, and which amounted to several ounces, and evaporated this solution to dryness; it dissolved very rapidly and effervesced strongly, though my acid was only of a moderate strength. The dry mass dissolved in water with a fine green colour; but there remained a small residuum of a greenish-white colour, composed of iron, nickel, and arsenic acid.

V. With carbonate of potash I decomposed this nitrate of nickel, which still contained a considerable quantity of copper, as will be seen in the sequel. I exposed to the fire the carbonated metal, which was of a brilliant green, but not so green as carbonate of copper. The colour changed during this operation into a very dark green, with a slight shade of grey and brown: when exposed to a more violent heat, the brown and grey cast became stronger, at the same time the matter collected into a mass, and small metallic particles were perceived in it. As I was unable to melt this substance in a reverberating furnace, I distributed it into several crucibles, and placed them in a porcelain furnace, at the spot where the fire is so violent that even the most solid crucible is destroyed.

* The oxyd of nickel communicated to porcelain a dark and disagreeable colour, varying between brown and black, and in which metallic spots might here and there be perceived. The same was the case with cobalt which contained nickel, and the blue was at the same time very dirty.

VI. The porcelain fire, which is usually kept up eighteen hours, had not acted in the same manner on all the crucibles; those which were placed in that part of the furnace where the porcelain bakes more slowly were scarcely changed, and the matter had only collected into a mass. In the other parts it had become liquid, but the crucibles were likewise brought into a state of fusion. Having broken them, I found in the melted mass pieces of metal of different sizes, and of the form of a kidney; the largest were of the size of the nut, and the smallest did not exceed that of a grain of millet: their metallic lustre was a medium between silver and tin. The scoria was of a greenish-brown, approaching the colour of the amethyst, and in several places it was of that dark blue which is generally perceived in melted oxyd of cobalt. The brown colour was owing to the oxyd of copper, which was absolutely vitrified; the blue to the oxyd of cobalt, and the green to the arseniate of nickel, which powerfully opposes the reduction, unless some combustible substance be added. I tried the metallic grains on the anvil, and observed, with much pleasure, that they possessed a great degree of ductility. They were strongly attracted by the load-stone.

VII. As it was impossible for me to separate all the small pieces of metal by the hammer, I reduced the remains of the crucibles to powder, and washed them. I then divided the metal, which I had obtained by these operations, into several small crucibles, and exposed it once more to the heat of a porcelain furnace, in the hope of procuring larger masses to forge them into bars. The fire acted in a manner as various as in the reduction; in several of the crucibles I had one large piece of metal which was completely melted, but in those that were placed where the heat was less intense the pieces only

only adhered to each other, and did not melt till they were removed to another situation.

VIII. As the frequent repetition of the preceding experiments had convinced me that oxyd of nickel may be reduced without the addition of any combustible substance, I made a trial with the oxyd of nickel, which had not been obtained from the metal of the impure nickel, mentioned above (reduced by the assistance of a combustible body), but by the decomposition of the triple salt, of which I have frequently spoken, and of which I had collected a considerable quantity from experiments, continued without intermission for a year and a half. The results were likewise very different, several of the crucibles contained a single piece of nickel with a scoria, which was completely melted, and of a dark brown colour, with a shade of green and the colour of amethyst, and a few blue spots. The other crucible only contained kidney-shaped globules of nickel, interspersed among the scoria, which had melted only to the consistence of paste; and those that had been exposed to a less violent heat contained a matter which had merely formed itself into a mass, and shewed here and there small metallic particles.

IX. I again exposed the two last kinds to a porcelain fire; the result was the same as in the preceding experiments. I had some crucibles with the nickel in a single piece, and separated from the scoria, and others, in which there were globules of nickel in the scoria. With the latter I repeated the operation till I saw, by the perfect liquefaction, that there was no more metal in the scoria. And, lastly, I had in some crucibles a scoria which had been so liquid as to make a hole in their bottoms, and the metal of the nickel had run into the cavities of the support. The largest piece of nickel produced by melt-

ing several small ones, weighed only an ounce and a half. It was melted in a place where the fire had destroyed all the other crucibles, and it was fortunate for me that this was very strong at the bottom, for I remarked in it a commencement of liquefaction which had nearly penetrated through it.

X. To spare the necessity of melting the same matter so often, I added to my oxyd of nickel an equal part of porcelain-enamel, but my success by this process was still less complete; for a considerable quantity of the nickel formed with the enamel a mass of a very dark brown colour, with a greenish cast, which had been liquid, and notwithstanding this the separation of the detached pieces of nickel had not been prevented. This experiment was more successful when I only covered the oxyd of nickel, which was to be reduced by itself, with a small quantity of enamel, after it was put into the crucible. The best method is invariably to expose to the fire, without any addition, the oxyd of nickel which has been purified by the humid way as much as possible.

I at length obtained several ounces of metal, which I consider as absolutely pure nickel, but not without a great expense of time, patience, and money. I am therefore enabled at present to describe in part its peculiar properties, of which I hope to furnish a better account at some future time.

XI. I shall begin with the preliminary description of the character of nickel absolutely pure.

A. The colour of this metal is between that of silver and pure tin.

B. It is not liable to be changed by the operation of the air and the humidity of the atmosphere; that is, it is not subject to rust

C.

C. It is perfectly ductile. When ignited it may be formed into bars, and when cold it may be beaten into very thin sheets on the anvil. By this property nickel is excluded from the class of semi-metals, and entitled to a place among the perfect ones.

D. Its specific weight, or its density, is considerable. The weight of melted nickel is 8,279, and that of forged nickel is 8,666.

E. The tenacity of this metal likewise appears to be considerable, and hence I conclude that it possesses a high degree of ductility. I tried to beat cold, on the anvil, a piece of melted nickel, weighing five drams. To prevent its cracking, I ignited it, and left it to cool slowly. As the piece of melted nickel had deep cavities, which I did not wish to level in beating, that I might not mix the iron of the anvil with the surface of the nickel; and as I kept the latter during the operation between paper, the holes naturally became larger in proportion as the nickel grew thinner. After the sheet had been several times folded, and again beaten out, it had, without reckoning the holes, a surface of nearly thirteen square inches. By comparing the extent of the sheet (which was fixed by means of its weight) with its surface, it will be seen that nickel may be formed into sheets not one tenth of an inch in thickness. Hence I conclude, that it might likewise be drawn into wire of no greater diameter, and it is my intention to make the experiment the first opportunity.

F. Nickel is extremely difficult to be melted, at least as difficult as manganese. On this subject no accurate experiments can be made, even by putting two crucibles into the same fire, for I have found a difference in making the trial with specimens of nickel or any other metal. This result depends greatly on the point to which the

the flame is directed, and this point is extremely variable.

G. The oxyd of this metal may be reduced at a very elevated temperature without the addition of any combustible body. It is its property of being so difficult to be melted that causes the difficulty of this reduction, by which it is at the same time purified. On igniting it but little oxydation is perceived in this metal; it only becomes rather more dull than gold, silver, and platina. Thus nickel belongs not only to the perfect, but likewise to the noble metals.

H. Not only the effect of the load-stone on nickel is very powerful, and but little inferior to that which it produces on iron, but the former likewise becomes magnetic, and acquires polarity on being rubbed with the load-stone, or, if circumstances are favourable, by the hammer, or by the file.

I once perceived polarity in a bar of nickel, which I had forged with a piece of iron, used for charging a load-stone; for though the bar was filed, it did not adhere to the load-stone so well as those whose surfaces were unequal, but, on turning it round, it adhered equally well, and I then observed that it attracted not only needles, but likewise thin plates of nickel, an inch and a half square, and that it drew them from their places on a smooth table at some distance.

It is a curious experiment to put a bar of nickel between a plate of that metal, laid upon a table, and a load-stone at a suitable distance above it. At the moment when any of these three bodies is brought near the other, but not so as to touch, the plate rises, but immediately falls, when the bar is removed, even without lowering the load-stone.

I. Nickel

I. Nickel preserves the property of being magnetic even when it is allied with copper. It however loses a little of its power when too much mixed, but arsenic justly deserves to be called the destroyer of this power. I have frequently had occasion to make this observation: if, for example, I had carefully purified, by the humid way, the oxyd of nickel from the iron * and arsenic which it contained, the result, after its reduction by the aid of a combustible, was a very ductile metal, subject to the attraction of the load-stone. But if I had not taken sufficient pains with its purification by the humid way, I obtained a metal less ductile, and much less powerfully attracted by the load-stone; and this want of magnetism could never be supplied even by melting it several times in a porcelain furnace. It will be perceived by the experiments of which I shall presently treat, that copper cannot be separated from nickel in the humid way: this was the reason why I had such a great loss in the metallic mass if I dissolved, precipitated, or reduced by itself, nickel reduced by a combustible substance from oxyd purified in that manner; but at the same time I remarked, that I had lost nothing but strange substances.

K. Sulphuric and muriatic acids have very little action on nickel. I employ the latter to polish this metal when it has lost its beautiful metallic lustre by the fire or the

* The best method of separating the iron is to evaporate quickly a solution of the nickel which contains iron with pure nitric acid. The iron separates from it in this operation like an oxyd which does not combine with the solvent. By this process a small quantity of arsenic is likewise separated, but it is preferable to separate it first by absolutely neutral nitrate of lead. After purifying the solution from the copper and arsenic it contained, the excess of lead may be precipitated by the sulphate of potash.

hammer,

hammer. For this purpose I boil it in the acid, which nevertheless dissolves but a very small portion of it. The most convenient means of dissolving it are nitro-muriatic and nitric acids.

I have already observed (Article IV.) that nickel, while still impure, (especially if it contains copper,) dissolves quickly and with effervescence in nitric acid. This acid acts in a different manner on absolutely pure nickel, particularly after it has been beaten.

I put grains and plates of nickel in pure nitric acid, supposing that it would attack them rapidly; but the solution was effected so slowly, that I was obliged to employ the heat of a lamp with alcohol to hasten it. I decanted the liquor after it had ceased to dissolve the metal, and added a farther quantity of the same acid, but, all at once, the solution took place with such rapidity, and so much effervescence, that I was obliged to remove the porcelain vase, containing the mixture, as speedily as possible to the chimney of my laboratory, to give a free passage to the vapours.

XII. I shall now proceed to state some other properties of nickel, which manifest themselves when it has lost its metallic state.

A. The solution of nickel in nitric acid is of a beautiful green colour. When it is decomposed with carbonate of potash a precipitate of a bright apple green is formed. This precipitate being washed and dried is very light; its absolute weight being as 2,927 to 1000 parts of the nickel employed.

B. When the carbonate of nickel is exposed to a red heat, its green colour is changed to a blackish-grey, with scarcely a shade of green, and at the same time a considerable loss takes place in the weight. Oxyd that has been so exposed weighs 1,285, if the metal of nickel be

taken

taken at 1000. If you continue to increase the heat, it approaches gradually to the metallic state, and the small black and greyish particles are attracted by the load-stone. This effect is much more speedily produced if the oxyd of nickel be wetted with a little oil before it is placed on the fire.

C. By adding to a solution of nickel pure ammoniac in excess, you obtain a colour resembling that of ammoniacal copper, but it sometimes changes in less than two hours into an amethyst red or a violet: by the addition of acid this violet is changed into green; but if you add ammoniac that colour turns to white, and changes as before. If to a solution of nickel you add a quantity of solution of copper, which does not sensibly alter the tint, the blue colour produced by the addition of the ammoniac is not altered; and if you add a small quantity of ammoniacal copper to the ammoniacal nickel when it is of an amethyst red, the latter colour instantly disappears.

Hence it follows, that a nitric solution of nickel, to which ammoniac has been added, is not pure when it remains white: and as no solution of ammoniacal nickel has hitherto been produced of an amethyst red, it is certain that the nickel which has been combined with ammoniac has always contained some copper *.

* It is almost a year and a half since I remarked this change of colour, on exposing to the fire a mixture of ammoniac with oxyd of nickel containing cobalt of copper, and frequently repeating this operation in the hope of separating the copper from the nickel, from which I afterwards separated the cobalt. The triple salt of ammoniac, nickel, and sulphuric acid, sometimes underwent the same change of colour when it contained an excess of ammoniac; at that time I attributed this alteration to a small remainder of cobalt. In certain circumstances, which I have not yet been able to determine, the amethyst red changes again to blue when the liquor is left to repose.

I must intreat the reader to be satisfied for the present with these statements relative to the properties of absolutely pure nickel, till I have leisure to make more numerous experiments with that metal, which cannot be considered as pure unless when it is reduced by itself. But I shall add one remark concerning the difficulty of the process of reduction. I have elsewhere demonstrated, with a mathematical evidence, that the gold in red enamels is not oxydated, but is in a metallic state. The gold is not separated from the enamel but by a much more violent heat than that which is required to melt it, on account of its state of extreme division. The same is the case with respect to nickel; as the colour of gold when very much divided is red, so that of nickel when divided in the same manner is a blackish brown. The enamel of porcelain mixed with it shews that colour; and as the nickel is more difficult to be melted than the enamel, and as a more violent heat is required to separate the metal than to melt it, the reader will easily perceive why I had a loss in mixing the oxyd of nickel with the enamel to reduce it, as mentioned in paragraph X; and likewise why the loss was less considerable when I merely covered the oxyd with enamel.

In the latter case, the oxyd and the enamel could not combine in as great a quantity as in the former, because they touched each other at fewer points.

Extract

Extract from a Memoir on the steeping of Wool, and the Influence of its different States on Dyeing. Read to the National Institute by J. L. Roard, *Director of the Dyeing Establishment in the Imperial Manufactories.*

By M. Bouillon Lagrange.

From the Annales de Chimie.

NOTWITHSTANDING the labours of a Dufay, a Hellot, a Macquer, and the important investigations of Messrs. Chaptal and Berthollet, dyeing still presents a great number of problems, which are the more difficult to be resolved in proportion to the number and variety of its agents. For, besides the effects produced by the nature of the primary substances, by the action of the water, of the air, of the caloric, and by the degree of attraction of the colouring principles for vegetable and animal substances, the difference which may exist in the state of the substances to be dyed may occasion very remarkable alterations. M. Roard, who is charged with the superintendance of the dye-houses belonging to the imperial manufactories, has constantly observed that wools of various qualities, subjected to the same experiments, were coloured in a manner more or less intense, whenever he was desirous of forming a comparison between them. These differences, in the degree of affinity for the colouring parts, are owing to a modification of the wool, of which he intends to treat in another memoir.

But the effects which particularly excited his astonishment, were those presented by wools perfectly alike in their external qualities, which assumed in the same bath very different colours. It was of the greater importance, says the author, to enquire into the cause of this difference, as dyeing, whose influence over many of the arts

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is so powerful, is the basis of the manufactories of tapestry; and as the slightest error in the production of a colour renders it totally useless and unserviceable. This strictness in the choice of colours is in an especial manner observed in the manufactory of the Gobelins. The zeal and the exertions of M. Guillaumot, and his indefatigable perseverance in destroying deep-rooted prejudices, have brought that establishment to such a degree of splendour and perfection, that the pictures of the most celebrated painters are transposed to its productions in a manner equally accurate and astonishing. The execution of the tints destined for that manufacture is at present attended with the greater difficulties, because, instead of operating as formerly with a series of colours taken as it were at random, it is necessary to find precisely the shade required, to follow the insensible gradation from light to dark through an harmonious succession of thirty or forty colours. But how can a dyer, however he may be accustomed to all the operations of this kind, be sure of obtaining invariable results, when, besides a multitude of well-known causes, minute differences in the degree of torsion alter the affinity of the light, and when the least mixture in the substances to be dyed causes a considerable variation in the affinity for the colouring principle.

Some experiments he had already made on the wool of animals in different states, caused M. Roard to imagine that a more extensive investigation of the subject would make him acquainted with the cause of the changes he had before observed.

M. Tessier, to whom agriculture owes such important improvements, persuaded him to prosecute his experiments, and endeavoured, in the most obliging manner, to facilitate his researches by procuring him fleeces of

merinos

merinos in the grease from animals in health, diseased, and such as had died of the rot.

That he might be sure of obtaining the most accurate results, M. Roard with the greatest care preserved the wools of these three qualities as unmixed as possible, and all the operations to which they were subjected were either performed by himself, or under his immediate inspection. The wools of the healthy, dead, and diseased animals, corresponding to the numbers 1, 2, 3, were employed separately, together, and mixed with scrapings, *(pelure,)* wool of very inferior quality, and which has besides been altered by lime.

Scowering and bleaching are so intimately connected with the operations of dyeing, that the author thought fit to begin his comparative observations with these preliminary processes, and even to extend them to the grease, the constituent principles of which were precisely explained in M. Vauquelin's memoir on the nature of that substance.

The agents which he employed for scowering wool, either in the fleece or spun, are, 1, grease; 2, soap; 3, caustic potash; 4, hot water; 5, boiling water; 6, Flanders soap.

1. These wools being treated separately with their grease, according to the universal custom, were not completely free from grease. No. 1 was very white, perfectly free from all impurity, without the smell of sheep; but on rubbing it between the fingers, a matter somewhat greasy might be perceived. The wool of the beast No. 2, which had died of the rot, was extremely dirty, charged with earth and animal matters; after being scowered, it had still a yellowish grey colour, some smell, and was more greasy than the preceding. In the fleece of No. 3, attacked with a languid disease, were a great quantity of ticks.

ticks. That insect had not a little contributed to aggravate the disease of the animal, whose soft, weak wool was of a greenish-yellow colour, which distinctly announced its decay.

2. Part of the wool of each of the preceding numbers being treated hot with $\frac{1}{20}$ of soap, became very white, and perfectly free from the grease; it had very little smell, which exposure to the air speedily removed.

3. One-fortieth part of caustic potash scowers and whitens wool extremely well; but this method, though very efficacious, is attended with too many inconveniences to advise its employment.

4. Wool steeped for some time in hot water lost, by the action of the potash, too little of its greasy matter to be employed in that state.

5. It is dangerous in all the operations of scowering to raise the temperature of the bath above 60°, or to leave the wool in it longer than a quarter of an hour, for it is liable to be very soon injured in boiling water.

6. Flanders soap is the substance which appeared to act in the most advantageous manner; it scowers very speedily, and gives wool a degree of whiteness which it is extremely difficult to produce by any other means.

On a comparison of wool spun in the grease and afterwards scowered, and that scowered before it was spun, it appeared that the former had become exceedingly white, resembling the colour of unwrought cotton, while the second retained a dull yellow cast, from which it can never be freed. This last experiment frequently repeated, and in several different ways, constantly afforded the same results. It perfectly agrees with the ideas current in the work-shops, that wool badly scowered can never be thoroughly cleansed from grease, and that a great part of the preparations it may receive in dyeing are never fixed

fixed in a solid manner. Thus, besides the advantage of sparing proprietors an operation which they never execute perfectly, a twofold cause ought to induce them to preserve wool in the grease; in the first place, to protect it from insects and grubs, which seldom attack it in that state; and in the second to allow the various arts which employ white wool the means of giving it that purity and lustre which it can never acquire when it has been previously scowered.

The author has tried on similar portions the effect of gas and sulphuric acid; but neither of those means was capable of giving to wool, twice scowered, the same degree of whiteness as to that which had been completely freed from grease at once.

These experiments furnished him with the means of ascertaining a fact which he had long before observed; namely, that the whiteness, so far from being the same in substances belonging to different classes, even varies in the produce of the same class: thus the white of cotton will never be the same as that of thread, and a difference will always be perceived between the whiteness of wool and silk, in the same manner as we distinguish, though with greater difficulty, the numerous products of individuals of the same family. For it cannot be doubted that, if even the same disposition of the surfaces could establish between all these bodies a certain identity for reflecting the light, yet as their affinity varies from the the smallest difference of their nature, this alone would be sufficient to produce alterations in them.

My intention, says M. Roard, in continuing these researches, was not to add any thing to the experiments of M. Vauquelin on this subject, but to prosecute trials I had long since commenced, and to ascertain the influence which the state of the animal must exercise over the grease, and the nature of the wool.

The

The grease is a fatty, unctuous substance, with a very strong smell, which is supplied in the sheep by sweat, and the transpirable matter emitted by all other animals. When dissolved in water, and filtered to disengage it from the earthy and animal matters which adhere to it, it is of a beautiful yellow fawn colour, more or less inclined to red, and composed, according to M. Vauquelin, of a soap with a basis of potash, animal matter, lime, and potash, combined with carbonic, acetic, and muriatic acids. Filtration likewise separates a white matter, floating on the surface of the grease, and which in scowering does not combine with the alkalies; it appears to be of the same nature as suet; it melts, and becomes liquid, at a low temperature, and takes fire very easily.

The animal matter dissolved by alkalies is precipitated from it of a reddish-yellow by all the acids that themselves preserve that colour, because they retain a small quantity of it. Oxygenated muriatic acid and oxygenated muriatic acid gas alone form in it a white flaky precipitate, which is coloured by exposure to the air; it is a kind of paste, soft, somewhat viscous, of a dirty yellow colour; it speedily becomes liquid, and burns with a bright white flame.

This matter, when kept for some hours at 80 degrees, in several pounds of water, is totally insoluble; but by evaporating the liquid, you obtain a small quantity of a soft matter, of a dark brown colour, which has an agreeable smell, resembling that of the extract of liquorice. He was the less surprised to find this smell in the grease, as in his experiments, made in the year 1800, by which he first demonstrated the presence of potash in it, he remarked that ammoniac, kept in digestion with this substance, gave it a strong smell of orange flowers, and that all the ancient writers, who treat of the medical

properties

properties of the *æsype*, and its fetid smell, agree that after a very long period it changes to an agreeable odour, resembling that of ambergris.

Alcohol treated with the animal matter dissolves a resinous substance, of a pale yellow colour; it is precipitated in white flakes, of a light yellow, by water and by acids. Being desirous of attacking the yellow extremities of the parts of the wool from under the belly and the thighs of the animal, he treated them with alcohol, quick-lime, and caustic alkalies, but none of these agents was capable of changing their colour. It appears that the grease accumulated in those parts, together with the action of the air, produces a very intimate combination, which cannot be separated from them without injuring their texture.

Equal parts of the grease, Nos. 1, 2, 3, at the same degree of concentration, were filtered and evaporated nearly to dryness in capsules of porcelain. No. 1 furnished twice as much matter as the two others; it strongly attracted the humidity of the air, and became almost entirely liquefied by it. Acids acted on all three in the same manner, by producing a very decisive effervescence, After burning them in a crucible of platina, he separated from all three, by distilled water, or by nitric acid, caustic potash, slightly carbonated, or nitrate of potash, the weight of which was more considerable in No. 1 than in 2 and 3, which exhibited no very perceptible difference.

TO BE CONCLUDED IN OUR NEXT.

New, easy, and economical Method of separating Copper from Silver. By M. GÖTTLING.

From the JOURNAL DE CHIMIE.

THE Arts are in possession of four methods for separating copper from silver, all of which require the solution of the alloy of those metals in nitric acid. As the price of that acid is very high, M. Göttling resolved to try the effect of sulphuric acid, which, in comparison to nitric acid, is extremely cheap: the success of his experiment perfectly answered his wishes. The following is the description of this new method.

Ascertain by the touch, or in any other manner, the quantity of silver contained in the alloy, and for each part of silver take one part of sulphuric acid, and for each part of copper 3½ of the same acid. Dilute the acid with half its weight of water, and pour it into a matrass on the alloy, which must previously be reduced to very small pieces. To promote the action of the acid, it is adviseable to add one part more to sixteen parts of the alloy. Place the matrass in a sand-bath, and heat the contents to ebullition. In the space of two or three hours the alloy is commonly disunited, and converted into sulphate, particularly if care has been taken to stir the mass from time to time with a glass spatula. This mass is thick, and often hard. Add to it, while hot, from six to eight times its weight of boiling water, and leave it some time longer on the fire. The sulphate of copper dissolves, and the sulphate of silver is, for the greatest part, precipitated. Examine whether the whole be completely dissolved: if this be the case, suspend in the

mixture

mixture a piece of copper, or some pieces of money, slightly tied in a coarse cloth, and keep up the ebullition for several hours. The sulphate of silver will thus be decompesed, and the metal will be separated under the metallic form. To discover whether this separation is complete, pour into a portion of the liquor a few drops of a solution of muriate of soda. If a cheesy precipitate be formed, it is a proof that all the silver is not separated; and in this case the ebullition of the matter with the copper should be continued for some time longer. After the silver is entirely separated, decant the liquid part, wash carefully the silver precipitated, and ascertain the complete separation of the cuperose salt by the addition of a few drops of liquid ammoniac to the water in which that operation has been performed. This water, in case of the presence of that salt, is turned blue by the ammoniac. When the silver is thoroughly freed from the sulphate of copper, keep it as it is in dust, or melt it with a quarter or at most a half of its weight of nitrate of potash. Then mix the decanted liquor with the water that remains from washing, and evaporate it in a copper basin, to obtain from it, by crystallization, sulphate of copper or blue vitriol. The produce of this vitriol is at least equal to the value of the sulphuric acid employed.

If any parts of the alloy should still remain undissolved, they should be separated by decanting, and reserved for a future operation.

New Method of extracting raw Sugar from Beet-root. *By M.* Achard.

From the Neues Journal der Chemie.

HAVING properly cleaned the beet-roots, cut them in slices, and subject them to the press. The juice obtained from them is thick, and of a dark colour. Besides sugar it contains albumine, extractive matter, and other substances which must be separated from it before sugar can be obtained. It is in this separation that the essential part of the process of making sugar from the beet-root consists.

In a boiler of tin, or tinned copper, mix 100 lbs. of the juice of the beet-root with three ounces six drams of sulphuric acid, diluted in one pound of water, and immediately pour the matter into vessels, in which it must be left standing twelve, eighteen, or twenty-four hours. Twelve hours are sufficient, but it cannot sustain any injury in twenty-four, as the acid prevents any alteration of the juice. To separate the sulphuric acid, incorporate with the juice seven ounces and a half of wood-ashes, and afterwards two ounces six drams and a half of lime, slaked with water. The sulphuric acid causes the albumine to coagulate, and the ashes being composed principally of lime, together with the lime afterwards added, separate the acid under the form of a salt, which is difficult to be dissolved. It is well known, that in the West Indies, in the manufactories of raw sugar, and in our sugar-houses in Europe, lime is employed to promote the separation and crystallization of sugar.

After this operation it is necessary to clarify the juice of the beet-root; and, for this purpose, the juice is removed

moved into a boiler, set in such a manner that the fire can act only on its bottom. The fire is increased to a degree approaching to ebullition without stirring the liquid. The fire is then extinguished, and the scum is taken off as fast as it rises, in the form of large black flakes. The liquor must afterwards be passed through a wooden strainer, taking the precaution not to shake it too much, lest the sediment should be mixed with it, and stop the pores of the strainer. The scum and the dirt left upon the filtre serve as food for pigs.

The juice thus clarified and filtered must be poured into a boiler, with a flat bottom, to the height of only six inches, and it is then evaporated with a brisk fire. By this method you prevent the juice from being converted into a mucoso-saccharine liquid, which resists crystallization.

When the liquid is reduced by evaporation to one-half of its quantity, remove it into tin vessels, six feet high and six inches wide, having a cock at the distance of six inches from the bottom; and there let it remain two or three days. In this interval the juice deposits the rest of its impurities, and especially the gypsum which it retained. At the end of this time draw off the liquid, and pour it again, but only to the height of three inches, into the evaporating copper, and proceed to thicken it by a fire, gradually augmented to ebullition. In proportion as the sugar becomes concentrated, care must be taken to diminish the fire, to prevent it from burning, which would render it quite unfit to be converted into loaf sugar. When the juice has acquired the necessary consistence the fire must immediately be taken from under the boiler.

In half an hour pour the juice, thus boiled to a due consistence, into cones or moulds, the points of which

are

are covered with a piece of linen cloth, and into which has been put a small quantity of sugar-candy, broken into coarse pieces; after which remove the moulds into a place whose temperature is between ten and twenty degrees of Reaumur. When the different operations have been well executed, the greatest part of the sugar is crystallized in the space of twenty-four hours. If it is boiled too much, the whole is converted into a granulated mass, the interstices of which are filled with melasses.

After all the sugar is well crystallized, uncover the point of the mould, and place it over an earthen vessel, that the melasses may drain off: this, according as the juice is more or less boiled, requires three or four weeks. The sugar which remains in the moulds, and is of a yellow, more or less white, and in crystalline grains, of a larger or smaller size, according to the success of the process, is the sugar of beet-root.

M. Achard, with a view to save time, and to dispense with the necessity of employing vessels for settling, made an alteration in this method, which he at first followed. To the juice, when half evaporated, and gently boiling, he added, for 1,200 pounds of the roots, five quarts of skimmed milk, and a little afterwards one quart of vinegar, and in this manner effected the second clarification immediately in the boiler.

By refining, all the products furnished by West India sugar may be obtained from this sugar of beet-root, and by claying, it may be rendered equally white.

New Method of making Alum with Pyrites and Clay. By M. Lampadius, *Professor of Chemistry and Metallurgy at the School of Freyberg.*

Extracted by M. Daubuisson.

From the Journal des Mines.

I HAD long entertained the idea of deriving some advantage from the vapours of sulphuric acid which are disengaged from pyrites when they are burning. It is well known, that in this operation it is sufficient to set fire to them with wood, or any other combustible; and that they then continue to burn, the combustion being kept up by their own sulphur; and that during the operation a certain quantity of sulphuric acid is formed, which is dissipated without yielding any advantage.

In a journey which I took in 1799, to the vitriol-manufactory of Breitenbrunn, in the district of Johann-Georgenstadt, I had the pleasure to observe, that these vapours were turned to some account. The pyrites were burned in a furnace of a conical form, open at the top, and in the sides of which were apertures, with pipes conducting to a large square chest, filled with pyrites that had been burned and lixiviated, and had thus furnished vitriol. When the pyrites in the furnace are kindled, the aperture at the top is closed. The pyrites still continue to burn; the vapours enter the pipes and collect in the chest, called the condenser, where they blend themselves with the lixiviated pyrites. The latter still contain a quantity of highly oxydated iron, which combines with the sulphuric acid, and forms vitriol. When these pyrites have remained a sufficient time in the chest, they are again lixiviated, and more vitriol is obtained from them.

them *. Perfect sulphuric acid would not, in this case, be of the same service as vapours, which are not entirely saturated with oxygen.

This fact revived my ideas relative to the employment of the vapours which are disengaged during the burning of pyrites; but, before I proceed to state the experiment I made on the fabrication of alum, I shall introduce an observation concerning the process employed by M. Chaptal. That chemist burns the sulphur with the saltpetre, as is the practice in the English manufactories of sulphuric acid; he receives the vapours of sulphuric acid which are disengaged from the baked clay, and thus forms an artificial ore of alum.

But would it not be less expensive to oxydate immediately the sulphur of the pyrites by the atmospheric air? I think this question might be answered in the affirmative; for by the latter method two expensive operations would be spared, that of purifying the sulphur, and that of burning it with saltpetre, a substance which is at a considerable price. I admit that, in the process which I am going to describe, all the vapours are not turned to advantage; but if the apparatus be properly disposed, very little will be lost.

I shall first make a remark concerning the state of the pyrites, and of the clay employed. Pyrites, merely broken, are preferable to those which are triturated and washed, when they are to be piled one upon the other: if pyrites in powder be used in the furnaces, they should be mixed with a fourth part of clay, and hardened and dried in the form of bricks. The arsenic contained in

* What M. Lampadius here says is not perfectly correct. Water is made to fall continually, drop by drop, upon the chest: this water passes through the heap of pyrites, and keeps it constantly lixiviated.

the

the pyrites is not detrimental to the formation of the alum, because the arsenic being less volatile than the vapours of the sulphuric acid, stops at the commencement of the pipes, where care must be taken not to put any clay. As to the clay, that used by potters may be employed, provided it does not contain too great a quantity of iron.

In the old electoral laboratory I directed a reverberatory furnace, four feet long, two and a half wide, and two and three quarters high, to be constructed: the anterior part had an aperture a foot square, by which the pyrites were introduced. On the sides of the arch were apertures two inches in diameter, which could be opened and shut at pleasure. At the top of the vault was another, of an oblong form, conducting to a wooden channel, a foot and a half wide, but which, on account of want of room, was only twelve feet long, and terminated in a chest three feet in diameter. Such was the imperfect apparatus with which I made my first experiment.

I took a quintal of pyrites, triturated and washed, mixed them with half their weight of clay, and formed them into balls, which were gently dried. Another quintal of clay was likewise formed into balls, which were dried and baked, but only till the clay had lost its unctuosity, and was therefore more proper to receive the vapours of the sulphuric acid. The balls of the pyrites were placed in the furnace, on about a cubic foot of wood, intended for kindling the fire. The aperture in front was closed, and only those on the sides were left open: the balls of clay were exposed in the canal and in the chest to the vapours of the sulphuric acid. The combustion of the pyrites continued fourteen hours, and not a vestige of sulphur was deposited; that substance became entirely

volatilized under the form of sulphuric acid. The wooden channel was too short, as I had expected; the greater part of the vapours escaped; the trees and plants in the garden contiguous to the laboratory withered, and their leaves fell off. I was therefore convinced that the pyrites were completely oxydated in my apparatus. As soon as the operation was ended, the balls of clay were covered with an effervescence of alum, which, mixed with 4 *per cent.* of alkali, yielded alum.

However, as the greatest part of the acid was mixed with the alumine, without being saturated with it, I left the balls in a shed, exposed to the action of the air, from August 2, 1799, till the third of April the following year. At the expiration of that time I obtained an earthy mass, entirely covered with an efflorescence, and mixed with sulphate of alumine; being treated in the usual manner, it yielded three pounds and a half of alum.

This essay convinced me of the possibility of obtaining alum by this process, and that in a very economical manner: but, to ensure success, the tube should be made much longer than mine. The remaining pyrites may afterwards be employed in the manufacture of vitriol.

On the cleaning of Engravings with oxygenated muriatic Acid. By M. J. L. Roard.

From the Bibliotheque Physico-Economique.

FOR this purpose it is necessary to have a small conical cask of deal, one metre in height, and fifty or sixty centimetres in diameter, provided with wooden hoops. Adjust to it a lid, closing hermetically, and a double moveable bottom, on which place the engravings, which are separated, and supported by very fine glass tubes, rounded

rounded with care at the lamp. To mix the water properly with the muriatic acid, pour them both, by means of a funnel, into a large leaden pipe, which passes through the cover, and rests on the double bottom. Before the engravings are placed in the apparatus destined for cleaning them, they are divided into two parts; the first comprises those that are greasy, such as are glued on canvass, or pasted on paper; the second, those that are only stained and spotted with ink. Having placed all those of the first class in an earthen vessel, or a small cask of deal, fill it with a warm and very weak solution of potash, or a solution which may be procured by the lixiviation of ashes. Two or three hours are sufficient to take out all the spots: the liquor is then emptied out, and replaced with clear water, in order to remove all the alkaline parts which would contribute to weaken the oxygenated muriatic acid. The water being drawn off, and the engravings having become dry, place them in the bleaching-vessel, concentrically, either lengthwise or breadthwise, according to their dimensions, in the spaces left between the tubes, and so as not to be too much crowded, first introducing the largest, and reserving the middle for the smallest. By these means they may be the more easily extended, and in taking them out they are not liable to be torn. Having put on the cover, pour at the same time the water and the oxygenated muriatic acid into the leaden tube, which must then be taken out, that the apparatus may be exactly closed. Let the engravings be in whatever state they may, they are commonly clean in two or three hours, which may be ascertained by examining one of those placed in the centre. That the operator may not be incommoded by the smell, when the bleaching is finished, he must turn the cock, which, by means of a pipe, conducts the liquor into a

large covered vessel, placed under the apparatus; but as the gas and the acid with which the engravings are still impregnated might render the labour inconvenient, and even dangerous, it must be again filled with pure water. If the prints are on strong paper, they may be taken one by one out of the water; but if they are thin and much worn, it is better to draw off the liquid, and to let them harden. They are then laid to drain on hurdles, covered with linen cloths; after which they are washed on both sides with plenty of water, either on inclined marble slabs or on frames of white cloth. This operation is very essential, for the engravings sometimes turn yellow again very soon, when they have not been sufficiently washed. They are then spread on hurdles, provided with napkins, or on pasteboard covered with white paper; and that they may not dry too quickly, they should neither be exposed to the sun nor to a strong current of air. While yet a little damp they are laid between two sheets of fine paper, on which are placed pasteboards of the same dimensions. Thus arranged, they are disposed one above the other, and put into the press, where they must remain at least twenty-four hours. When the engravings are very valuable, they may be put into the press with plates of copper of the same size as the print itself, which imparts to them the highest degree of beauty and freshness. Care must afterwards be taken to expose them to the air and to the sun, to dissipate entirely the smell of the oxygenated muriatic acid, and not to put them into portfolios till they are perfectly dry. In spite of all the above-mentioned precautions, there may remain on the backs of those which were glued yellow spots, produced by the action of the oxygenated muriatic acid on the animal matter of the glue; but these may easily be removed by sulphuric acid.

By

By the method here stated, I have cleaned several hundreds of engravings in one day, notwithstanding the extraordinary pains I was obliged to bestow on such a great number of very rare and valuable prints; almost all of which were proof impressions, such as the battles of Alexander, some of the most beautiful landscapes by Woollett, &c.

Intelligence relating to Arts, Manufactures, &c.

(Authentic Communications for this Department of our Work will be thankfully received.)

New Process in the Cultivation of Melons.

IT is well known that in some years melons, in certain situations, lose their circular form, and grow larger on one side than on the other, and that these mis-shapen fruits are always bad. The ordinary method in these cases is to make slight incisions on the side which is the smallest; when the sap circulating to that part in greater abundance, the melon sometimes recovers its form, but seldom its quality. On the other hand, the scar indicates the operation it has undergone, and which, if the incision is too deep, causes the fruit to crack and spoil. The following simple method of restoring these faulty melons is both easy and certain. Take a small forked stick, proportionate to the size of the melon, and thrust it into the ground as near as possible to the tail of the fruit, taking the precaution to lay a little moss between the two prongs, for fear of injuring the tail, and suspend the melon to this fork. In a few days the melon will resume its form, when the fork may be removed, and the operation is finished. The quality of the fruit remains unchanged.

Method

Method of removing Spots of Grease.

M. Lenormand has discovered a new and easy method of instantly removing spots of oil, grease, and tallow, from any kind of stuff whatever, without changing its colour. Take five or six pieces of lighted charcoal, about the size of a walnut; wrap them in a piece of white and very clean linen, which has been previously dipped in water, and squeezed in the hand to press out the super-abundant water. Extend the stuff that is spotted on a table, on which a very clean napkin has first been spread; then take the cloth containing the charcoal by the four corners, and lay it upon the spot. Lift it up and put it down again on the spot ten or twelve times successively, pressing lightly upon it, and the spot will entirely disappear. When the spot is considerable, it sometimes goes through the stuff, and the grease or oil is imbibed by the napkin. But whether this is the case or not, when you lay the charcoal on the spot a thick vapour rises from it, which has the smell of the substance that caused it. Hence it is to be presumed, that the heat diffused by the burning charcoal volatilizes the water of the cloth in which they are wrapped, and thus decomposes the grease and oil, which it reduces to vapours. So much, however, is certain, that no spot of the above-mentioned nature has ever resisted this process.

Improved Method of making Varnish of Cobalt.

The varnish of cobalt, prepared in the ordinary manner, frequently has the great defect of being greasy, and not drying properly: that composed with ammoniac is liable to form a soap, and that made with camphor is too weak and less desiccative than the first. M. Demmenie, a Dutch artist, well known on the Continent for his

his extremely delicate works in glass, has published a receipt for a varnish exempt from all those defects. The process, consists merely in placing the cobalt in contact with the alcohol in the state of gas. Put rectified alcohol into a glass vessel prepared for this purpose; suspend, at a certain distance above it, a piece of cobalt, and place the whole in a *balnea mariæ*. When the alcohol is sufficiently heated to raise the gas, it touches the cobalt, and dissolves small portions of it, which drop into the liquor. Continue this operation till the drops that fall have saturated the alcohol, then withdraw the apparatus from the *balnea mariæ*, and let the liquor cool; decant it, and you will have a perfect solution, not containing any foreign matter. The varnish may be prepared in the same manner with oil of turpentine, by substituting the essence instead of alcohol. It should be observed, that this varnish will have only a very slight shade of the colour of cobalt.

Process for restoring its original lustre to Wood painted with Oil.

To clean wood-work, or any other object painted with oil-colours, a brush dipped in fresh urine is used with success. By this method the disagreeable smell of a new coat of paint is avoided. After the operation wash with clear water, to take away the smell of the urine.

Means of clearing Houses, &c. of Rats and Mice.

A plant, which grows in abundance in every field, the Dog's Tongue, the *Cynoglossum Officinale* of Linnæus, has been found by M. Boreux to possess a very valuable quality. If gathered at the period when the sap is in its full vigour, bruised with a hammer, and laid in a house, barn, granary, or any other place frequented by rats and mice, those destructive animals immediately shift their quarters.

quarters. The success of this method, says M. Boreux, is equally speedy and infallible; the only inconvenience which attends it is, that by driving the rats and mice from your house you subject your neighbours to their depredations.

List of Patents for Inventions, &c.

(Continued from Page 160.)

MALCOLM COWAN, of Gloucester-place, Portman-square, in the county of Middlesex, Commander in the Royal Navy; for improvements in the construction of sails for ships and vessels of all descriptions. Dated June 11, 1805.

ROBERT BARBER, of Billborough, in the county of Nottingham, Gentleman; for new and improved modes of making and shaping stockings and pieces, and also some new and improved kinds of stocking-stitch and warp-work. Dated June 14, 1805.

THOMAS JAMES PLUCKNETT, of Butt-lane, Deptford, in the county of Kent, Gentleman; for a method of mowing corn, grass, and other things, by means of a machine moving on wheels, which may be worked either by men or horses. Dated June 15, 1805.

WILLIAM COLLINS, Lieutenant in the Royal Navy; for a ventilator, upon a new or improved construction, for the purpose of ventilating tents and marquees of every description. Dated June 20, 1805.

JAMES NOBLE, of Coggershall, in the county of Essex, Worsted-spinner; for a machine for discharging a wool-comb or combs, by separating the tears from the noiles, and drawing what is commonly called a sliver or slivers from the comb or combs after or before the combs are worked, or the wool is combed upon the same. Dated June 29, 1805.

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

No. XL. SECOND SERIES. Sept. 1805.

Specification of the Patent granted to Mr. James Sharples, *of Grosvenor-Place, Bath; for new invented Combinations and Arrangements of Implements and mechanical Powers, and certain Principles and Forms of Tables useful for Surveying, and various other Purposes.*

Dated November 24, 1804.

With a Plate.

To all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, I the said James Sharples do hereby declare, that my inventions consist, first, in the following particulars. Two or more wheels, pullies, rings, rollers, chains, or cords, toothed or notched, with different numbers of teeth or notches, are any how so arranged as to be capable of being impelled an equal number of teeth or notches at a time, so that a successive variation or combination of their parts or points will take place, by which the number of impulses that formed them may be ascertained. And what distinguishes this part of my invention from all others intended for ascertaining distances, and counting animal or mechanical motions, is, that the wheels,

 pullies,

pullies, &c. that compose the instrument may be separated and enclosed in different compartments of the same box, or in separate boxes, or in separate rooms; provided they are equally moved by the same power, a notch at a time, or (if they are rings, rollers, &c. of different diameters) an equal portion of their peripheries.

Let there be two wheels, marked with characters corresponding with the number of their teeth, and a fixed pointer fast in the pins that they move upon; and suppose that by any animal or mechanical motion each wheel has been impelled twenty-three teeth, the larger will have made two revolutions and three over, the smaller two revolutions and five over; these numbers three and five, which I call indicial, will appear at the pointer as in the annexed figure A, (see Plate XII.) Set down the plenary numbers ten and nine, and their indicials opposite to them; subtract the first indicial 3 from its plenary number 10, and 7 remains, to which add the indicial 5 = 12; but as 12 is more than its plenary number 9, nine must be subtracted from it, which leaves 3; multiply the plenary 10 by 3 = 30; subtract the remainder 7, and 23 will be the number sought. This rule will answer for any two consequent numbers whatever; or if there are two points, one at the plenary 10, another at the plenary 9, they will separate, and coincide by 90 impulses, at each of which the point 9 will have advanced on the wheel 10 $\frac{1}{90}$th part of its circumference; so that if one of the wheels is graduated with 90 points, and any hand or other pointer is fastened with (or formed out of) the other wheel, each impulse will be designated thereby. If the index is for ascertaining time or distance, a socket may come through the under wheel, and a hand may be fixed upon it to traverse either upon the upper wheel or upon a dial-plate, fixed thereto, graduated with any portions

tions of time or distance. Again, let there be any two odd numbers, differing by 2, as 11 and 9, any how equally impelled from the points at their plenary numbers, and the indicials 3 and 7 are found at certain points, on the figure B. Here 15 being greater than the plenary 9, nine must be subtracted; and, as the difference between the plenary number is 2, the remainder 6 must be divided by $2=3$ and $3\times11-8=25$, the number sought. This rule will answer for any two consequent odd numbers.

Let there be three wheels C, any how equally impelled from their plenary points to their indicials 5, 1, and 7; subtract the first indicial 5 from its whole number 11, and 6 remains; add the second indicial to the differential 6, and place the sum 7 under 6; then add the indicial 7 to the differential 6, and the sum 13 being an odd number, the number 9 must be taken from it, and the remainder is 4, which divided by 2 quotes 2, which place under the differential 7; subtract the differential 7 from 2; but if that cannot be done, add the number of the middle wheel 10 to it, and it will be 12, then 7 from 12, and 5 remains; multiply this remainder by the wheel 11, and that product by the wheel 9, and the last product will be 495: to this sum add the product of the differential 2 and plenary 11, multiplied together, that is 495 and 22 equal to 517; from which subtract the first differential 6, and 511 remains, which is the number sought. This rule will answer for any three consequent numbers, the middle one being even. Example: $84+100-100=84$ and $\frac{100+11-99}{2}=6$ and $6\times101=606$ and $6+100-84=22$ and $22\times100\times100=220000$, to which add $606-100+22=220184$ *, the number sought. All the numbers necessary to appear will be seen in the following example.

* This result is erroneous, but it agrees with the original.

101.	51	50
100.	4	54
99.	33	379191
		87
		379104 number sought.

This rule is so easy in its application, that my daughter, a child of eleven years old, can answer any question relative to this combination extending to a cycle of 999900 almost as soon as she can write down the figures. The great advantages of this mode of counting are, the very small expense attending the instruments, and that every impulse is designated without fractional parts. This peculiarity distinguishes my numerical indexes from all counting instruments that I am acquainted with; for example, if one hand of a counting-engine moves over a circle of 10 which signifies 1000, another over a circle of 10 which signifies 100, and another of 10 which expresses units, the pointer in the circle of 1000 is progressing a fraction of $\frac{1}{1000}$ part of its circle at every impulse, and the hand in the circle of 100 $\frac{1}{100}$ part, which occasions much uncertainty in extensive counting when the engine has been a little time in use, for the pointers in the different circles will not exactly coincide at their whole numbers. The endless variety in which the combination wheels may be put in motion by connected and intermediate powers are obvious to every mechanic, such as cords, chains, pinions, wires, springs, levers, endless screws, pendulous and falling weights, &c. but some of the following contrivances of my own I mean to use.

Let there be two or three ratchet wheels on the same arbor, fixed in a shallow box D; and a double spring, that

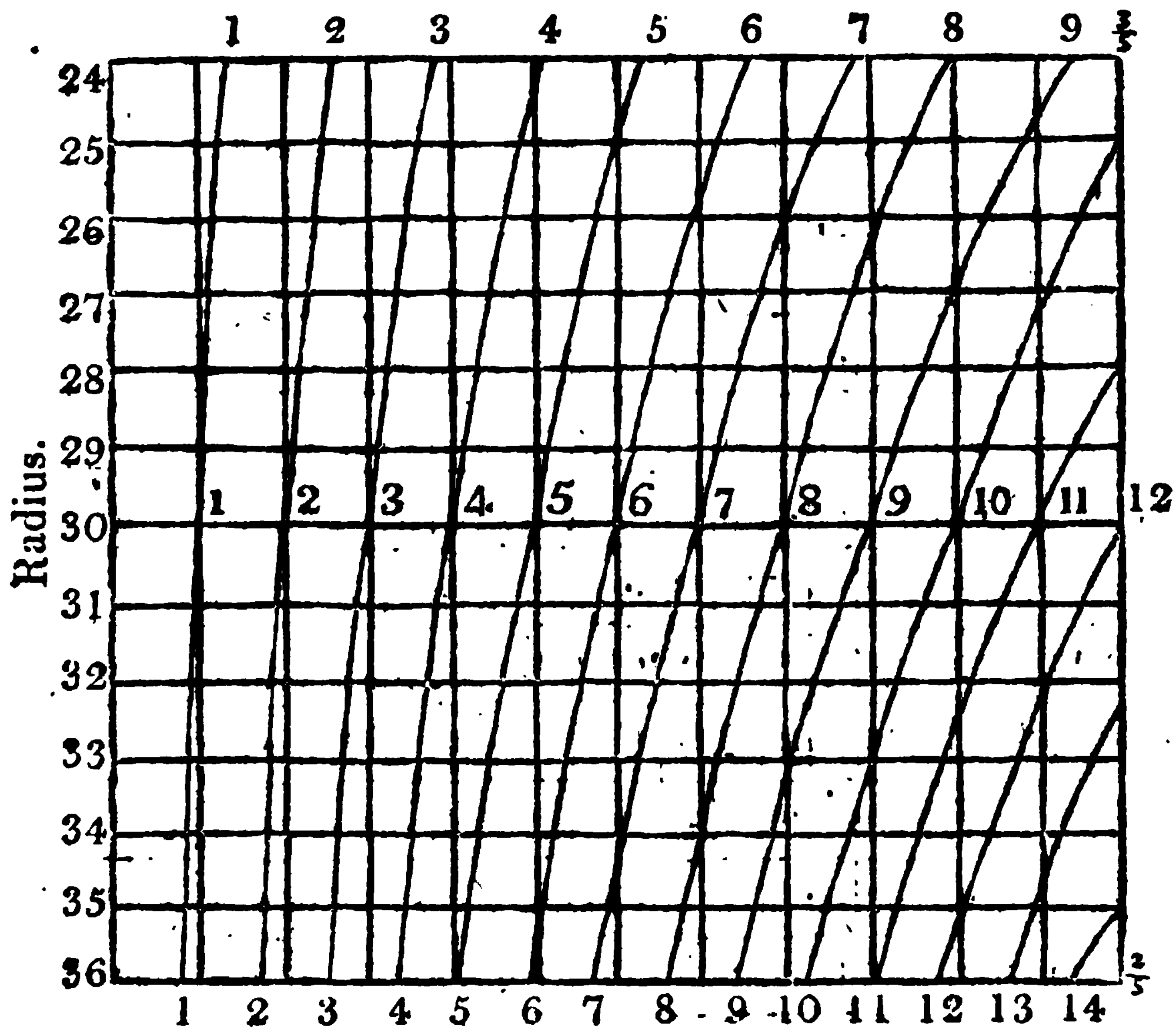
that is made weakest at its extremities, be put round the wheels; if the sides are pressed together by any mechanical or animal agency, one end of the spring will push forward the wheels, and the hook of the other will approach it; and when the spring is set at liberty it will, by returning into its situation, perform the same office, whilst the opposite end will escape over a tooth in each, so that every impression on the spring will impel the wheels forward. Now if a cord or wire, fixed round the spring, which may be either confined in a perforated groove cut in the box, or in the sides of the spring, be alternately braced and relaxed by pulling at the end *b*, the action required will be performed: or if the sides of the spring are any how pressed outwards, by its return inwards the same effect will take place, so that, by means of a string, wire, or chain, motion may be communicated to the instrument from a considerable distance. If action is required to be given to it on the inside of carriages, let there be a spiral box, spring, and pulley, moveable upon an axis P, at the end of the spring S, which must be screwed to the projecting part of the axletree-bed that covers the hob of the wheel within about a quarter of an inch of the hob. Upon the hob screw a slip of wood, metal, or strap, that, by coming in contact with the pulley, will give it a few turns at every revolution of the carriage-wheel, and wind up the spiral-spring in the box. It is evident, that as soon as the pulley has passed over the projection on the hob the spiral-spring will return again into its situation. Now if a cord or wire is fixed to wind round the pulley, and be conveyed to the spring of the instrument within the carriage, it will put it in motion by alternately bracing and relaxing it. Again, if the spring and pulley be fixed to a horse's neck, and a set of combination wheels are connected

connected with the spring-box, the real distance a horse or other animal moves may be very nearly ascertained. Let the spring box have a click attached to it, so that when any length of cord is drawn from it the click shall move a wheel with any number of small teeth in it, which wheel at L shall have a pinion connected with the combination wheels of 101, 100, and 99; every step the horse takes a quantity of teeth will be driven forward in the first wheel proportionate to the length of the horse's pace, which will be all summed up in the combination wheels; and lest any person should find a difficulty in my rules before described for counting by them, I have contrived the following modes of tables, which will answer for any three consequent numbers, the middle being an odd one. If it were required to count any number of impulses on the combinations of 21, 20, and 19, move the wheels till the plenary number 20 and 19 coincide with their respective index points on the figure C; then observe at what number the plenary 21 stands at; let these be moved, by any power, a tooth at each impulse.

When you wish to know the count, if the wheel of 19 teeth C should stand at 12, the wheel 20 at 3, and the wheel 21 at the point it set out at, look in the first line of the table for 12, and in the column under it for 3; then the number directly above the column 12 added to the number at the end of the marginal line in which the other number 3 is situated will be the number sought; or if these numbers are expressive of distance, the characters may be formed by different coloured ink amongst the figures; but if the wheel of 21 is not at the point at which it set out, move it forward till it arrives at that point, only observe how many teeth it required to advance it thither, for so many must be deducted from the sums found in the margin; every combination of three consequent

consequent numbers is counted by tables constructed in this manner. If the instrument is for ascertaining the distance any carriage runs, I select any two or three consequent numbers that shall nearly, by the combinations they will form, make a cycle that will be completed in even miles or furlongs by a wheel of thirty inches radius. Two wheels, one of 63 and another of 64, will, when impelled together, make a cycle of 4032, which is nearly equal to 12 miles, by a wheel of 30 inches radius; but in order that this combination may serve for carriage-wheels of different diameters, I have contrived the following table.

VARIATION TABLE.



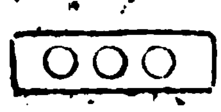
The figures in the first column express the radii of wheels of every size from four to six feet in diameter, and the distance is found in miles where the diagonals intersect the lines on which the radial numbers are arranged. If a distance of ten miles is found on the instrument,

ment, and the carriage-wheel to which it is applied be 27 inches radius, the real distance will be only 9 miles, by a wheel of 24 inches 8 miles, by one of 33, 11 miles, and by one of 36, 12 miles.

COMBINATION TABLE.

21	42	63	84	105	126	147	168	189	210	231	252	273	294	315	336	357	378	399	
2	4	6	8	10	12	14	16	18	1	3	5	7	9	11	13	15	17	19	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	[illegible]	17	18	19	
20	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	399
19	20	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	798
18	19	20	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	1197
17	18	19	20	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	1596
16	17	18	19	20	1	2	3	4	5	6	7	8	9	10	11	12	13	14	1995
15	16	17	18	19	20	1	2	3	4	5	6	7	8	9	10	11	12	13	2394
14	15	16	17	18	19	20	1	2	3	4	5	6	7	8	9	10	11	12	2793
13	14	15	16	17	18	19	20	1	2	3	4	5	6	7	8	9	10	11	3192
12	13	14	15	16	17	18	19	20	1	2	3	4	5	6	7	8	9	10	3591
11	12	13	14	15	16	17	18	19	20	1	2	3	4	5	6	7	8	9	3990
10	11	12	13	14	15	16	17	18	19	20	1	2	3	4	5	6	7	8	4389
9	10	11	12	13	14	15	16	17	18	19	20	1	2	3	4	5	6	7	4788
8	9	10	11	12	13	14	15	16	17	18	19	20	1	2	3	4	5	6	5187
7	8	9	10	11	12	13	14	15	16	17	18	19	20	1	2	3	4	5	5586
6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	1	2	3	4	5985
5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	1	2	3	6384
4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	1	2	6783
3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	1	7182
2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	7581

The

The combination table is graduated into miles by red * figures at every sixteenth square, commencing from the combination 2 and 1 under it; the whole cycle will be 23 miles and $\frac{3}{4}$. The three combination wheels C are supposed to be here connected and inclosed in a box; and they may be put in motion by a lever X, which is driven, by a falling weight, on the other side the plate, in a different compartment of the box, and will alternately strike a tooth in the wheels of 19 and 20; if the box is any how fixed to a strap, and buckled round the spokes of any carriage-wheel, the falling weight will impel them each a tooth at every revolution of the wheel. The same contrivance will sometimes be resorted to when the numerical index is used for counting the steps of a man or horse; a box, containing a set of these wheels, will be fixed to a band or garter, which may be buckled or tied round the leg, or fastened to the knee, but in such a manner that the weight shall fall at each step to the side of the box, in an angle of about 45, as at *z*; but at the knee it may be inverted, and fall at the same angle or less, for at every impulse the velocity of the weight, which equals that part of the leg to which it is attached, is continued at every step, which, by a centrifugal exertion, rises upwards till it meets with an obstacle, it then returns to its situation by its own gravity. The same effect will be produced if the index wheels and plate are moveable upon the pin x, for in this case they will act the part of the weight, or with two wheels, as in figure B; or if they are situated upon a straight plate, thus , and it is suffered to slide freely in a box or groove against a fixed pin. In fine, there is such an endless variety in which these wheels may be disposed of, that it would be impossible,

* These figures are shewn in the table by being reversed, and the progressive numbers left out.

with all their uses, to describe them in the compass of a specification; besides, it would be a needless introduction of extraneous matter, except in arrangements of my invention. The index G is sometimes used for ascertaining distances walked, with combination wheels of about 78 and 77, which will make a cycle of 6006 steps, equal to about 6 miles; one of the wheels, or a dial-plate moving with it, therefore may be graduated with six characters of any kind, and divisions made amongst them to suit any person's general rule of walking. At the upper side a ribband is fast to the string or wire that goes round the spring, or is connected with two screws fast in the sides of it *o o*. At *y* is a ring or hook: if this is fastened any where above the ancle, knee, or hip-joint, and the string any where below, the action of the joint will give action to the instrument. If it is required to give action by a weight to two combination wheels, graduated with characters to express distance, a lever, as at figure C, may be made to move a spring, fixed to a circular piece of thin metal, moveable upon the same axis with the wheels; or the spring in the figure D may be loosely fixed to a separate plate, as at *o o*, and fixed in the box at the point *g*. The box, by the revolution of the wheel, will act as a weight, and the springs will alternately open and close at their point, and give the action required. A small crank or pinion, coming from a ratchet-wheel under the plate in figure C, will sometimes be used to give motion to the combination wheels, see the figure I. The ratchet will be moved by the weight *w*, with spring fixed to it and counter spring screwed to the plate. *s s* are the two springs.

Another part of my invention consists in certain modes of giving motion, at the end of every revolution of one wheel, to a tooth in another wheel, upon the same axis. Let there be any number of wheels K on the same axis, and

and let the first wheel be impelled in the same manner as the wheel I; upon one side of the wheel let there be a pin *c*, or a spiral projection P, to raise the lever S. As soon as the lever has escaped the projection or pin, the spring S will force it downwards. At the end of the lever is another spring, which is made to act on the wheel adjoining it. Any number of wheels may be thus impelled, and they may have any number of teeth, according to the uses for which they are intended; if they are wanted for measuring distances, they may be graduated with poles, furlongs, miles, &c.; if for counting mechanical or animal impulses, with the nine digits and a cypher; by the wheels thus decimally arranged, the figures on the wheels will represent the number of impulses without any fractional parts. Again, let there be any eccentric projection in one of the wheels, and a double spring in the other, made to slide backwards and forwards in the axle on which the wheels move. If the eccentric projection in one of the wheels is applied to the projecting points in the other as at *s s*, the eccentric projection at each revolution will drive the spring backwards and forwards, whilst the spring in contact with a ratchet on the side of the wheel will drive it forward at one end, and escape over a tooth at the other. The advantage of this mode is, that the machinery is concealed in the small cylinders, the outsides of which will be marked with the nine digits and a cypher each, so as always to shew the number of impulses, nearly arranged in a line, as at K *o*.

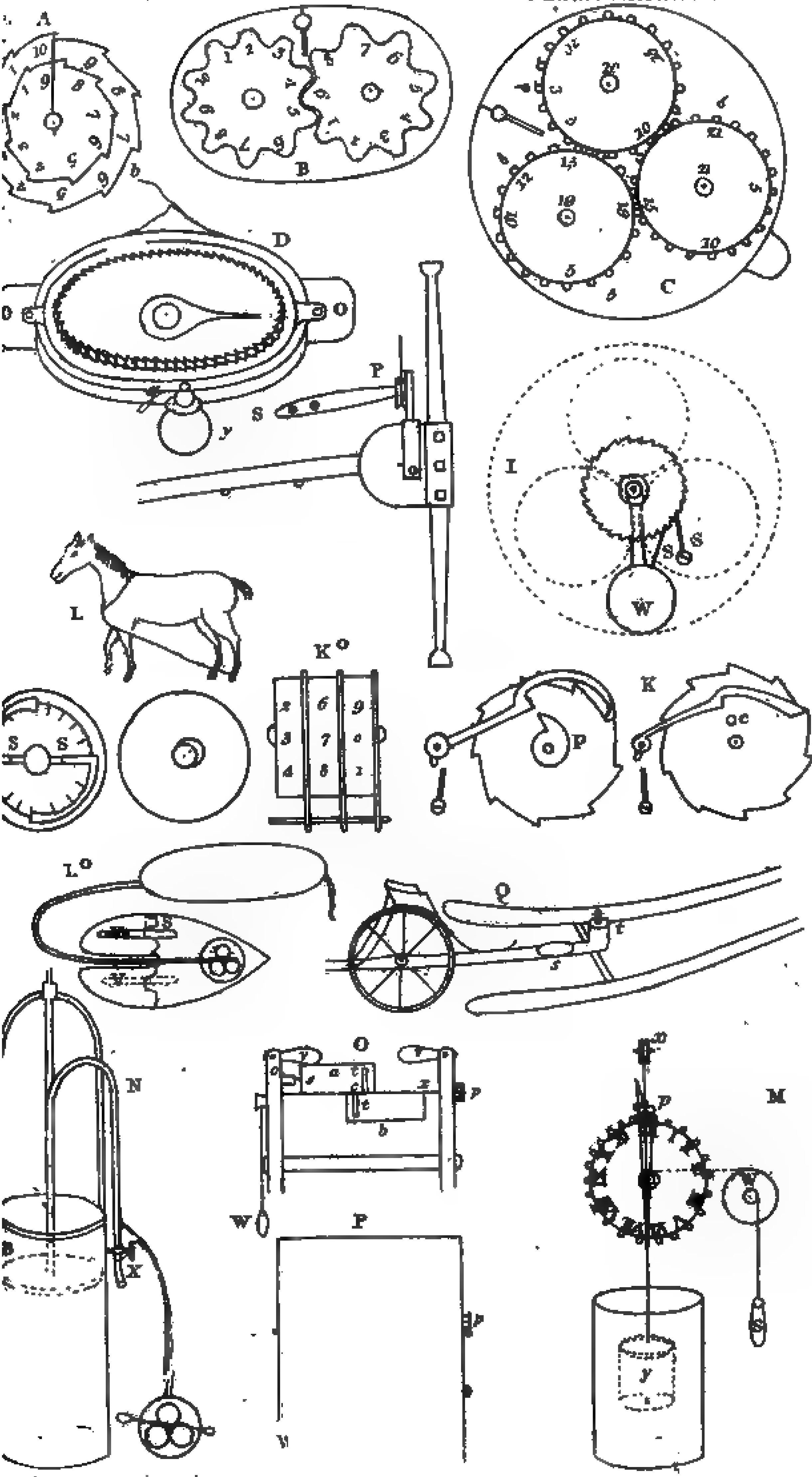
The combination wheels may sometimes consist of four numbers, as at 13, 11, 10, 9. Find the number sought for 11, 10, and 9, as before directed, suppose the number to be 829, divide it by 13, the remainder is 5, and let 3 be the number at which 13 is found, then $\frac{13+3}{2}=8$ and $8-5=3$ and $3\times11\times10\times9+829=3799$.

For

For the application of the combination wheelsto rotary sea-logs great advantages will result, on account of the small friction of its parts. L *o* is a piece of iron, fixed to a log of wood, to one end of which a rope is fastened to drag it in the water; to the end of it a piece of brass may be fixed as an axis for the box and vane *v v* to act upon; the box may be made water-tight; and an endless screw on the brass axis, which, connected with the wheels in the box, will give them motion as the vanes and box are driven round by the resistance of the water.

The vanes are moveable against a small spring, which will contract themselves in proportion to the resistance they meet with in the water as at *s*.

The combination wheels will extend to various useful purposes, as wind-gauges, reels, and the measurement of cloth, &c.; and where regular motions can be obtained from sand or water, time-pieces may be constructed, see figure M. Let there be two wheels, one upon another; let the axis of the lower wheel be fast, and project through the upper one, to which fix an index hand. W is a pulley, drawn by the weight *s*, to which a string is attached, that puts the wheels in motion, by drawing from the axis of the first wheel. The wheels are connected with the pinion *p*, to the axis of which a crank is fixed, which raises and depresses the cylinder *y* in a vessel of water. This acts the part of a pendulum, for in the bottom of it there is a hole, to admit the passage of water; to regulate the time, the hole may be enlarged or contracted; a weight at the end of a spring, over the pulley *x*, balances the cylinder *y*. Again, let there be a syphon N, fixed at one end to a float B; at the other end there is a cock, to regulate the quantity of water that is to pass out at it; as the water is diminished in the cylinder the floating syphon will descend, and the drops from


A
B
C
D
I
L
K°
K
L°
Q
N
O
M
W
P
X
S
y

from it become regular; and if they are made to fall upon the end of a balance, to which the combination wheels are fixed, the number of drops may be ascertained, and the wheels graduated accordingly, or figures expressing the hour may be marked upon the syphon. If the front wheel in the time-piece M has sixty teeth and the under one fifty-nine, each fifth tooth in the front wheel will indicate minutes, and five revolutions one hour, which the index hand from the lower wheel will shew by its progress on the front wheel. If the pinion has five teeth, the crank will make a revolution in one minute; the cylinder, and its hole and weight, must therefore be so regulated as to make a revolution of the crank in one minute. The same effect will be produced by a pendulum upon an escapement-wheel, that revolves in one minute. O is a water-escapement. Two vessels *a b* are fastened to the axis *x*, but balanced upon the centre *c*. The vessels are joined together, and air-tight; one of them is filled with water. There is a communication from one to the other by the tubes T T. N V are weights that rest alternately upon the vessels. The water passing from the upper to the lower one will, as soon as it preponderates over the weight N, raise the point *s* over the obstacle *o*, the weight *w* drawing at the same time from the axis *e*, will turn the vessel *b* uppermost. The water it contains will then pass into the other vessel, and an alternate motion obtained, which may be communicated to the numerical index by a screw or pinion at *p*. The sand-escapement P is upon the same principle; but the vessels are joined together at *s*, so as to admit them to act separately. As soon as so much sand has escaped from the upper vessel into the lower one as will overcome the weight *v*, it rises above the obstacle *o*, and the weight *w* draws the frame F round upon its axis, and brings the [illegible] weight.

[illegible]

weight is against the same obstacle at which it stops till it is overcome by a balance of sand.

My arrangement for the particular purpose of surveying is a combination of a slay and wheel, which I call a geographer, as represented at Q. The pole of the wheel is supported at T by a swivel, which has a horizontal motion within a socket at the end of the pole, and a perpendicular one on its own axis. The advantage of this over the perambulator is, that it may be drawn by a horse, and that the surveyor may ride in the seat fixed upon the pole. If the wheel is ten feet in diameter, and acts by a crank on its axis, upon the numerical index at S, the number represented thereon will be the number of feet by adding a cypher to the end of it.

In witness whereof, &c.

Specification of the Patent granted to THOMAS BARNETT, *of East-street, Lambeth, in the County of Surrey, Mathematical Instrument-maker; for an Invention whereby a requisite Quantity of Air would introduce itself into any Vessel containing Fluids, or a superabundant Quantity of Air therein discharge itself, so as to preserve the Fluid in a constant State for Use, notwithstanding a Diminution of its Quantity, and prevent its being flat or dead by an improper Communication with the external Air, or the bursting of the Vessel by an Expansion of its Contents, as frequently experienced by Persons conserving Liquors, particularly when fermenting.*

Dated November 6, 1804.

With an Engraving.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in pursuance of the proviso hereinbefore mentioned to be contained in the hereinbefore in part recited letters patent, I the said Thomas Barnett

nett do hereby declare that my said invention is described in the plan hereunto annexed, and in the particulars hereinafter set forth; that is to say: It consists of a tube, which may be made of glass, earthen-ware, brass, copper, or any metal or material of which a tube can be formed; which tube resembles in shape, in the upper part, an inverted syphon, into which is to be inserted such a quantity of quicksilver, or other fluid, as will fill up the diameter thereof, at the curve or circular bottom of the instrument; the long leg, or branch of which, is to be inserted into the vent-hole, bung-hole, or aperture, in the upper part of the cask or vessel; which hole or aperture should be so closed as totally to prevent any air from passing into or out of the cask or vessel, excepting through the tube. The consequence of which will be, that by every alteration, either of the quantity of the fluid within the cask or vessel, or its state, the quicksilver, or fluid in the tube, will be operated upon, and will vibrate, or be forced towards the enlarged part of either of the branches of that part of the tube denominated herein an inverted syphon, and marked A and B in the delineation thereof, (see Fig 1, Plate XV.) as the case may be, so as to permit a sufficient quantity of air to introduce itself into the cask or vessel, or to emit itself therefrom, as occasion may require; immediately after which the quicksilver or fluid will resume its situation, operating in principle as a perpetual stopper, valve, or regulator. By which properties the invention possesses the advantage of adjusting the atmosphere within the cask or vessel, preserving thereby the liquor in a constant state for use, and preventing its becoming dead or flat, notwithstanding a diminution of its quantity, and also prevent its bursting the cask or vessel during its fermentation, which it must inevitably do when the cask or vessel is closed with the common vent-peg, and which, if

if taken out to prevent this inconvenience, and not reinstated the instant fermentation has subsided, the circulation of the atmospheric air on the surface of the liquor will occasion it to become dead and flat, and unfit for use; both which events the instrument or regulator in question is calculated effectually to prevent.

In witness whereof, &c.

Specification of the Patent granted to SAMUEL LUCAS, *of Sheffield, in the County of York, Refiner; for a Method of separating the Impurities from Crude or Cast Iron without fusing or melting it, and of rendering the same malleable, and proper for the several Purposes for which forged or rolled Iron is now used; and also by the same Method of improving Articles manufactured of Cast Iron, and thereby rendering Cast or Crude Iron applicable to a Variety of new and useful Purposes.*

Dated May 13, 1804.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said Samuel Lucas do hereby declare that my said invention of a method of separating the impurities from crude or cast iron without fusing or melting it, and of rendering the same malleable, and proper for the several purposes for which forged or rolled iron is now used, and also by the same method of improving articles manufactured of cast iron, and thereby rendering cast or crude iron applicable to a variety of new and useful purposes, is described, and is to be performed, in the manner following; that is to say: The pig or cast iron being first made or cast into such form as may be most convenient for the purposes for which it is afterwards intended, is to be put into a steel converting or other proper furnace, together with a suitable quantity of iron stone, iron ore,

some

some of the metallic oxyds, lime, or any combination of these, (previously reduced into powder or small pieces,) or with any other substance capable of combining with, or absorbing, the carbon of the crude iron. A degree of heat is then to be applied, so intense as to effect an union of the carbon of the cast iron with the substance made use of, and continued so long a time as shall be found necessary to make the cast iron either partially or perfectly malleable, according to the purposes for which it may be wanted. If it be intended to make the iron perfectly malleable, from one-half to two-thirds of its weight of iron stone, iron ore, or other substance, will be found necessary; if only partially so, a much less quantity will be sufficient. Five or six days and nights will in general be found sufficient during which to continue the heat, which, towards the close of the process, cannot be too great. Care should be taken that the pieces of cast iron be not of too great thickness, as it would have the effect of lengthening the process. But the proportion of the the several substances made use of, and the degree and duration of the heat to be applied, must greatly depend not only on the nature of those substances, but also on the nature and quality of the pig or cast iron employed; a knowledge of which can be obtained only by experience. The cast iron to be rendered malleable, and the substances to be made use of for that purpose, may be placed in the furnace in alternate layers; and, in order to prevent the iron stone or iron ore from adhering to the iron, a thin layer of sand may be placed between them. For the improvement of articles manufactured of cast iron, the same directions may be observed; except, that when the articles are small a less proportion of the substances for producing malleability will be required, and also a less degree and continuation of the heat.

In witness whereof, &c.

Specification of the Patent granted to Job Rider, *of Belfast, Clock and Watch-maker; for certain Improvements on the Steam-Engine.* Dated March 26, 1805.

With a Plate.

To all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, in the said letters patent recited, I the said Job Rider do hereby declare that the following is a true description of my invention, which consists of various improvements in the steam-engine; that is to say: First, in lining the steam cylinder or cylinders with a soft metal, or a composition of metal, similar to hard pewter, of a sufficient thickness to admit of finishing the inside of the cylinder or cylinders of such metal by drawboring or otherwise. Secondly, in applying a hollow piston-rod, answering the purpose of an eduction-pipe. Thirdly, the order of opening and shutting the valves. Fourthly, in regulating the engine's speed by a pendulum.

First. With respect to the first-mentioned improvement of lining the steam cylinder or cylinders, I do not think it necessary to describe minutely the manner of doing it, as the practical methods are well known of lining cylinders, by casting pewter, or a compound of metals, round a core, placed in the centre of an iron cylinder, or otherwise; my object is in applying it to steam-engine cylinders, whereby a more perfect inside can be made than when cast iron is used only, permitting the piston to work more smoothly, and be less liable to friction and corrosion than iron; for this reason also I recommend finishing the inside by drawboring, making each stroke lengthways. By this means I make the piston fit closer into the cylinder than is commonly done, so that little or

or no steam can escape past the piston, consequently less steam will be consumed in working the engine; the friction of the piston's action will be lessened, and the stuffing upon the piston will last longer, without being renewed, than any engine's having the piston's action in cast iron.

Secondly. The piston-rod being made hollow, and to act through a stuffing-box fixed upon the piece that stops the lower end of the steam-cylinder, the piston in the steam-cylinder being fixed to its upper end, and the lower end to act through another stuffing-box into a condenser, by this means the piston-rod also serves the purpose of an eduction-pipe, having a valve to the upper end, above the piston in the steam-cylinder, opened and shut occasionally in working the engine by the necessary work connected to it. By this mode of a hollow piston-rod, answering the purpose of an eduction-pipe, a direct motion and power can be obtained for the purpose of pumping water without beam or lever, and render the engine more simple.

In certain cases I recommend, but do not claim it as a new invention, the application of a solid inverted piston-rod, having the lower end to work the air-pump, by being fixed to its piston, and the upper end fixed to the piston in the steam-cylinder working through stuffing-boxes, one fixed to the top of the air-pump, and the other to the bottom of the steam-cylinder; when the solid piston-rod is used, inverted or otherwise, the valves may be placed as described under the following head.

Thirdly. *The following is a Description of the Valves, and of their Situations in the Engine.* Fig. 1, *a a a a*, is a piece of casting, of an oblong shape, serving the purpose of steam-chests, eduction and steam pipes. *b b* is a partition cast in it. *c c* is a round pipe, having a

 flanch

flanch *dd*. *eeee*, oblong figured pipes to admit the valves 2, 3, 4, 5, with their necessary appendages, as shewn in the drawing. *fghij* are rods, whereby the valves can be shut or opened by pushing them in or drawing them out: these rods pass through stuffing, to render them air and steam tight, shewn in the drawing by small dots. The cast-piece *aaaa* is fixed to the side flanches of the steam-cylinder, having the apertures from the top and bottom of the steam-cylinder closely connected unto the apertures in the part *a a*, between the valves 2, 3 and 4, 5. *k* is a pipe, connecting the above part unto the boiler, and *l* is a pipe in like manner, leading to the condenser.

The order of opening and shutting the valves, according to the engine's motion, is shewn in Fig. 2. The dotted circle represents a supposed circle, formed by a crank, &c. moving in it, with the power of the engine connected to it. The arrows exhibit the direction of the motion; the figures 1, 2, 3, 4 and 5, refer to the different valves; and the letters S and O signify the shutting and opening of them, according to the order and place by them denoted. The method of connecting the rods *f g h i j*, for the opening and shutting the valves in the order above described, may be accomplished in various ways, according to circumstances. The saving of steam, by the order of opening and shutting the valves above described, will be evident upon comparison of my method with that in common use in other engines, in which all the steam contained between the piston and the eduction valve is lost (when the piston is at the extremity of its stroke either way) by being condensed with the steam that occupied the space through which the piston acts. But by my method it is different; as, for instance, suppose the piston

ton to be ascending; before it reaches the top of the steam-cylinder the valve 1, Fig. 1, is shut, next the valve 3, and then, when the piston has attained its greatest height, the valve 2 is opened, thereby permitting the steam to expand itself through the valve 4 to the other side of the piston before the valve 4 is shut; during which time no steam can come from the boiler until the valve 1 is opened, and in the descending stroke the like operation will take place, as shewn in Fig. 2.

Fourthly. *Description of the pendulum, and manner of regulating the speed of the engine by it.* Fig. 3, *h h*, frame plates, framed with pillars between them, as shewn at P P P P, Fig. 4. A A an arbor, having a nut *a a* upon it, with teeth cut into it. B B a main wheel, fitted, by means of the socket *b b* upon the main arbor A A turning upon the arbor, which is cut into teeth both at its extremity and also in the interior part of the rim, as shewn in Fig. 4. *e*, a small wheel, equal in size and number of teeth with the small nut *a a*, acting both in the arbor nut and interior teeth of the main wheel. F F a moveable barrel, fitted upon the main arbor for the line G, Fig. 4, to wind round, Y an arbor, upon which the wheel *e* is fixed, acting in both sides of the barrel F. By this means the barrel F is turned round upon the main arbor, while the arbor itself is turned by the nut *a a*, acting in the wheel *e*, and the wheel *e* acting into the interior teeth of the wheel B, thereby forcing round the barrel F upon the main arbor. C a pinion acted upon by the main wheel B, carrying round the escapement-wheel D, shewn also in Fig. 4. L a ratchet-wheel, fixed upon the end of the main arbor, which proceeds through the frame-plate, and has a click fitted to it that acts into its teeth. K a worm or endless screw wheel, fitted upon the other end of

of the main arbor. I, an endless screw or worm which acts on the wheel K. O O two pins for securing the wheels L and K upon the main arbor.

Fig. 4 shews the wheels flat, having the same letters of reference to the several parts as described in Fig. 3. M a pair of pallets, which are acted upon by the wheel D. N a pendulum-rod, connecting a pendulum ball to the pallets M, which, by means of the weight suspended to the line G, presses the wheels round that give power to continue the pendulum's motion by the inclining parts of the pallets, which are acted upon by the wheel D moving round. The speed of the engine is governed by this regulator in manner following.

The worm I, Fig. 3, is turned by the engine's motion, which winds up the weight suspended to the line G; which weight is connected to a lever in such manner that, according to the height of the weight, the lever permits the valve 1, Fig. 1, to open more or less; that is to say, when the weight is at its height the valve is least opened, and when descended to the bottom it is opened to the utmost. It is also necessary that the aperture of this valve be made in the form of an inverted cone. It was shewn in Fig. 2, that this valve shuts and opens twice every stroke, and this lever is not to prevent the opening and shutting of the valves as before mentioned, but to limit the extent of the opening by the rod *j*, Fig. 1, springing up to the lever, which is connected to the weight. These things being premised, it is evident, that should the engine wind up the weight by turning the worm I, Fig. 3, faster than the pendulum permits it to descend by the wheel-band D, Fig. 4, going round, the aperture of the valve 1, Fig. 1, will be contracted, and *vice versâ*.

The ratchet-wheel L, Fig. 3, with its click, is useful only when the worm I is thrown out of geer to keep the barrel

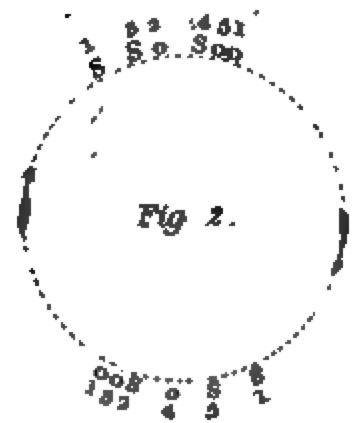


Fig 2.

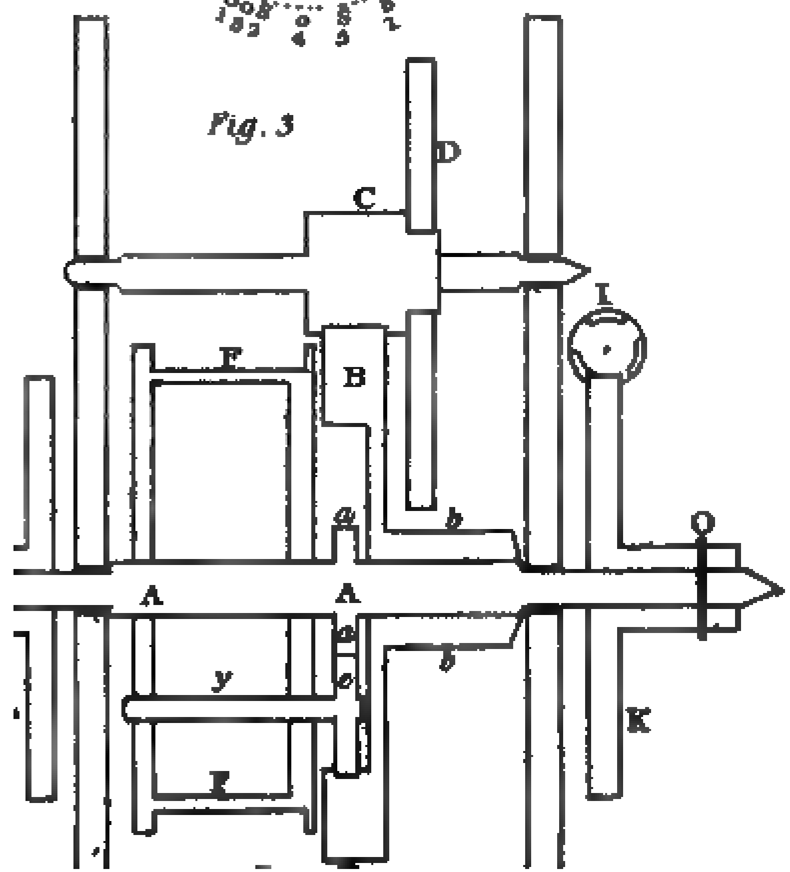
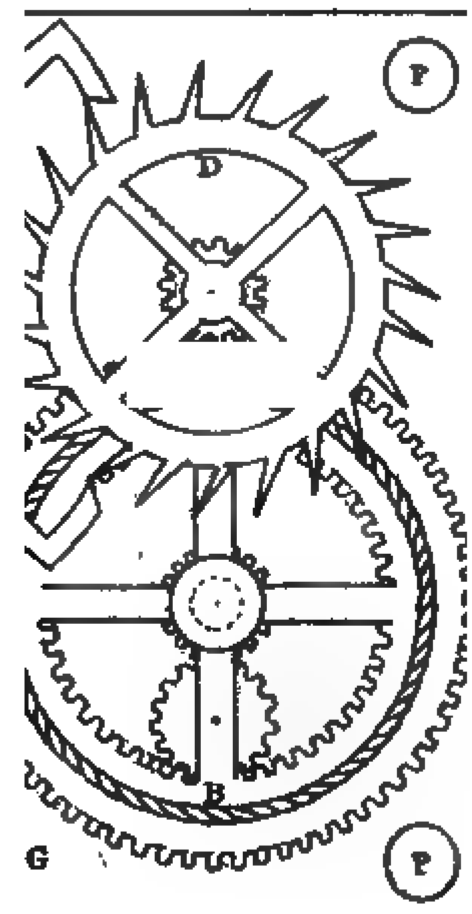


Fig. 3

Fig 4.



barrel from running the line off by the weight's gravity. By means of the aforesaid construction little power is lost, and the speed of the engine can be regulated to the greatest nicety, by adjusting the length of the pendulum, and in varying the number of teeth in the wheels.

In witness whereof, &c.

Queries relating to Dairies answered.

By JOHN CONYERS, *Esq.*

From the COMMUNICATIONS to the BOARD of AGRICULTURE.

Q. 1. *What is your breed of cows?*

Ans. The North Devonshire; having found by experience their superiority in every respect over all the others that I have tried. I might prefer the Herefordshire, if my land was firm enough to bear them; but mine, like the land in most dairy countries, is of a tenacious nature, and suffers by the treading of heavy cattle in the wet weather.

Q. 2. *How are they fed in summer and in winter? and what quantity or breadth of grass and winter crops do they consume?*

Ans. This must be regulated by the quality of the pasture; if extraordinary good, one acre will suffice; if moderate, one and a half. A Devonshire cow in milk, during the winter months, consumes about *one ton of hay, or rather less.*

Q. 3. *Are they kept in houses, or abroad?*

Ans. Certainly best kept in houses, whilst any fodder is given.

Q. 4.

Q. 4. *Are they ever fed with green food mowed, and with what effect?*

Ans. This, like most other dairy countries, produces very little green food, except the natural grass, and this is never mown green for fodder.

Q. 5. *At what age are heifers sent to bull?*

Ans. One of the greatest evils attending a dairy farm is, that of the cows slipping their calves, which is much occasioned by the heifers being sent too early to bull. Mine do not go to the bull before they are three years old.

Q. 6. *At what age is it most adviseable to dry cows for fattening?*

Ans. I think this a most important consideration. I have observed in this, and most other dairy countries, the practice is to continue milking or suckling a cow till her constitution is so exhausted that no power of fattening is left, and her flesh is then no better than carrion. In the vicinity of London, I am told, the Jew butchers purchase the cows that have been so worn out, at very low prices, to make sausages of. It is difficult to say precisely at what age a cow should be dried, as it must depend in some measure on the constitution of the animal; but on an average, I think, between the ages of seven and nine.

Q. 7. *What is the description of cows that, after milking, are the best adapted to fattening?*

Ans. The North Devon.

Q. 8. *At what ages are calves weaned, and in what manner treated?*

Ans. Calves are weaned from the time of their birth, such only being taken for that purpose as are calved early in the winter, so that they may be of an age to graze,

graze, as soon as there may be any grass in the spring; they are usually fed by hand with skim-milk and warm water, mine have an infusion of hay in the water.

Q. 9. *Average product of your cows in butter or cheese, calf, and hogs?*

Ans. Upon an average ten cows give five dozen pound of butter *per* week in the summer, and two dozen in the winter. A good North Devon cow fats two calves a year. My thirty North Devon cows have this year, upon an average, produced (a profit of) thirteen pounds fourteen shillings *per* cow.

Q. 10. *Have any, and what improvements been made in dairy utensils?*

Ans. None.

Q. 11. *Are there any circumstances in the management of your cow pastures which merit noting?*

Ans. The management of a cow-pasture, I conceive, does not differ from that of any pasture applied to other uses; it consists in not suffering any stagnate water to remain on the surface, or the land to be poached by the treading of heavy cattle in the wet season.

Soap-ash seems to be the manure which produces the sweetest sort of herbage. The wild carrot is the only weed I am acquainted with, which is pernicious to the taste of butter. It is on the old pastures only that the best butter is made.

Q. 12. *Have you any particular method of manufacturing butter or cheese worthy of communication?*

Ans. None, but what is generally known; extreme cleanliness is required in every part of it.

Q. 13. *How are the skim-milk and whey applied?*

Ans. Either to the fattening of porkers, or to the disposing of it at the rate of three pence *per* gallon to the

lower classes of the people, or to the taking of pigs to keep at the rate of from three shillings and sixpence to four and sixpence *per* week. I have known a hog fatted to the weight of sixty-six stone, without the offal, at eight pounds to the stone, fed only upon skim-milk.

Q. 14. *What is the consumption of salt in the dairy?*

Ans. One pint *per* week for the cream of ten cows.

With the addition of any other information which may be conceived useful.

From my observations on the management of dairy-farms, it appears to me that much loss to the public, and to the farmers themselves, is sustained in the produce of the cow, by butter, cheese, or veal, being the only objects of consideration; it is difficult to say what may be the amount of, but it must be very considerable, the meat that is wasted by negligence in procuring these articles. The management of a dairy being a matter of too much importance to be intrusted to the care of a servant, the fatigue of it generally falls upon the farmer's wife or daughters; the consequence of which of late years has been, that the use of the dairy has been much set aside, and the suckling of calves for veal substituted in its place. When this happens, the profits from the farm are diminished, the cows so employed are more rapidly worn out than those used for milking, and the neighbourhood, particularly the lower classes of it, suffer much from the deprivation of skim-milk for their families, or the means of fattening their pigs, by paying a weekly sum for the keep of them. No one, except those who have witnessed it, can conceive what an encouragement the latter practice is to the frugal and industrious husbandman; and if farmers would dispose of their skim-milk in this manner more generally than they do, instead of contracting with

pork-

pork-butchers for the sale of their pigs, they would find their profits full as great, and they would eventually conduce to the lowering of their poor rates. Less butter being made than usual, owing to the circumstance I have mentioned, and the great expenses attending a dairy, I conceive must contribute to the cause of that article increasing so much in price; but the management of a dairy, I believe, to be open to much œconomy. The consumption of fuel is an object of great consideration; and could the dairy-farmers be prevailed upon to use coal instead of wood, and be made acquainted with the improvements lately made in the fire-places for burning the former, they would soon be sensible of the advantages of it; such a practice is the more desirable, because it would be the means of the pollard trees being eradicated from, instead of being encouraged in, the hedges. The value of the hay which milch-cows consume in the winter is a great deduction from the profit of the dairy. No effectual substitute for it has, I believe, been hitherto discovered. It is not till the second week in May there is usually natural grass enough for the cows to subsist on; but this evil is likely to be alleviated by the introduction of what is known by the name of the cow-grass, which certainly appears to possess all the advantages of clover without any of its dangerous consequences, and is getting to be much cultivated; the difficulty of ascertaining whether the seed is genuine at the time of purchasing it, is the only impediment I know to its becoming more generally used.

On the Construction of Field Gates.

By Mr. CHARLES WAISTELL, *of High Holborn.*

With an Engraving.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Thanks of the Society were presented to Mr. WAISTELL *for this Communication.*

THE various methods used in bracing common gates for fields, prove that not one of them is greatly superior to the rest; for, if it was, that method would have been generally adopted. Most gates are loaded with superfluous timber in some of their parts, and are constructed upon such bad principles, that they are frequently broken by their own weight, aided by the concussion of the head against the falling-post; and this, long before any part of the wood begins to decay. I have for some time given this subject considerable attention, being impressed with the idea, that if common gates could be constructed with less timber, and upon better principles, the saving of timber only would be of national importance; for we have many millions of gates to uphold in Britain, and their numbers are annually increasing. Gates made according to my plan, possess great strength, are very light, and of easy and simple construction. Although uniformity of appearance be not essential in a common gate, yet it is worth having when it can be obtained, as in this gate, without additional expense.

My gate is made with short, and consequently less valuable, oak or ash timber, than those of the commonest construction; its strength is much greater than any other gate made with a like quantity of timber, there being at

four

four distant points between the head and the heel, two bars and a brace crossing each other ; and I doubt not that it will be found proportionably more durable : it is, besides, very easy to construct, and requires less labour than most other common gates. Twenty-nine years ago I designed plans for ornamental gates, with semi-oval and semi-circular braces, and had them executed ; the plans were sent to my friends in various distant parts of this kingdom, as also to Ireland ; and I have the pleasure to observe, that they are become almost the only ornamental gate in many parts of England. The plans of them I never published, although they were prepared for engraving fifteen years ago ; and I should be as indifferent about my present design, of a common field gate, if I did not conceive that its publication would materially benefit the public ; the introduction of this form being, I conceive, of some national importance, as timber has been lately greatly enhanced in price, and is rapidly on the advance.

This gate was designed for the approach to a country residence ; but for common purposes, the wicket on one hand, and the short length of rails on the other, may be omitted.

Reference to the Engraving of Mr. Waistell's Gate.

(See Plate XIV. Fig. 1.)

Dimensions.

The heel of the gate to be about	3½ inches square.
The head of ditto - - - -	2½ by 3 inches.
The top rail or bar - - - -	3½ by 1½ inches.
The bottom bar - - - - - -	3½ by 1¼ inches.
The bar in the middle of the gate	3 by 1¼ inches.
The other bars, and the 4 braces	2½ by 1¼ inches.

Observations

Observations on its Construction.

The head and heel of the gate may be of oak, and the bars and braces of fir. Narrow and thick bars, when braced as in this design, are stronger than broad and thin ones, containing the same quantity of timber, and they also oppose a less surface to the wind. The two points in the heel of the gate, to which the thimbles are fastened, may be considered as firm or fixed points. From these points, *viz.* 1 and 2, two braces to proceed to 4 and 3, in the middle of the bottom and top bars, and being there secured, these become fixed points, and from these two points, *viz.* 4 and 3, two braces proceed to 5 and 6, fixing those points. The gate is thus doubly braced, *viz.* from the top of the heel to the top of the head, by means of the braces 1, 4, and 4, 5; and from the bottom of the heel to the bottom of the head, by means of the braces 2, 3, and 3, 6. On each side of the gate are two braces, and those parallel to each other. The brace proceeding from the bottom of the heel of the gate, and that which is parallel to it, as also the bottom bar, are all strained in the way of compression, and the brace proceeding from the top of the heel, and the other brace which is parallel to it, and also the top bar, are all strained in the way of extension. The strains in this gate being none of them transverse, but all longitudinal, it would support a vast weight at its head without having its form altered. The braces all serve the double purpose of keeping the gate in its true form, and of shortening the bearings of the bars, and strengthening them. Few gates have less timber in their braces; and perhaps in no other way can a gate be so firmly braced with so small a quantity of timber.

At 3, 4, 7, and 8, two braces and a bar of the gate are firmly screwed together by means of iron pins and screw

nuts.

nuts. At the other points, where only one brace crosses a bar, common gate-nails are used.

If, in some cases, a strong top bar be wanted, to resist the pressure of heavy cattle, a bar or board, about six inches broad and one inch thick, may be laid with its broad side upon the top bar, and fixed thereto by means of the ends of the braces in the middle, and by the heel and head of the gate at the two ends of it. This board will, in this position, resist exactly the same pressure as a thick top bar, three inches broad by four inches deep, although it contain no more than half the timber.

In the ground plan, or horizontal section, 7 represents a piece of wood, about four inches cube, pinned to the falling post, a little below the catch, to stop the gate from swinging beyond the post: another stop near the ground may be useful.

When gates are hung to open one way only, their heels and heads generally rest against the hanging and falling posts; but when they are hung according to this design, gates may be made about one foot shorter for the same opening, and consequently they must be lighter, stronger, and less expensive.

Of the hanging of Gates.

When the two hooks in the hanging post are placed in the same perpendicular line, a gate, like a door, will rest in any direction in which it may be placed. But, in order that a gate may shut itself when thrown open, the hooks are not placed exactly perpendicular; the upper hook declining a little towards the falling post, or a few feet beyond it. In whatever direction that hook declines the farthest, in the same direction will the gate rest, if unobstructed,

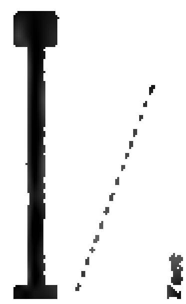
unobstructed, and its head cannot then sink any lower. Make the head describe half a circle, and it will thus have attained its utmost elevation, and will be equally inclined to descend either to the right or to the left *.

The following method of fixing the hooks and thimbles will, I think, be found to answer very well for a gate that is intended to open only one way. Supposing the face of the hanging post to be set perpendicular, and the upper hook driven in near its inner angle, as is represented in the preceding design, and that the lower hook must be four feet and a half below it; suspend a plumb-line from the upper hook, and at four feet and a half mark the post; then at one inch and a half farther from the gateway than this mark drive in the lower hook; this hook must project about half an inch farther from the face of the post than the upper hook. In the section or ground-plan of the gate, the two white circles near the hanging post represent the places of the two hooks when brought to the same horizontal line; that nearest the gateway represents the place of the upper hook. A line drawn through the middle of these two circles, and extended each way, will, on one hand, represent the gate's natural line of rest, and, on the other, the line of its highest elevation. A gate thus hung will, when thrown open nearly to the line of its highest elevation, return to the falling post with a velocity sufficient to resist a moderately strong wind. This velocity will be either increased or diminished, accordingly as the upper hook declines more or less from a position perpendicular to the lower hook. In order to adapt the thimbles to these

* See Chap. ii. of Mr. Parker's Essay on the Hanging of Gates; and also the Agricultural Report for Northumberland, by Messrs. Bailey and Culley.

hooks;

Pl XIV. Vol VII. Second Series.



hooks;—as the lower hook is one inch and a half farther from the gateway than the upper hook, the lower thimble must have its eye an inch and a half farther from the heel of the gate than the eye of the upper thimble, in order that the bars of the gate may be in a horizontal position when it is shut. And as the upper hook projects half an inch less from the hanging post than the lower hook, the upper thimble should be fixed half an inch nearer the farther side of the heel of the gate than the lower thimble, in order that the gate may be in a perpendicular position when shut. If the thimbles have straps embracing the heel of the gate, and proceeding a few inches along each side of the bottom and top bars, and if they are fixed to the heel bars and braces, by means of iron pins and screw nuts, great firmness will be given to the gate at those two points, which are those that suffer the greatest strains.

Description of a Machine, on the Principle of Hiero's Fountain, designed to raise Part of the Water of a Spring or small Brook, where some Feet of Fall may be acquired, to a greater Height, for the Purpose of watering higher Levels.

Invented by the late Dr. Erasmus Darwin.

Extracted from his Phytologia.

With an Engraving.

a b, Fig. 2, (Plate XIV.) the stream of water. *b c c*, the height of the fall of it, suppose ten feet. *d e*, two vessels of lead or iron containing, suppose, four gallons each. *f g h i k l*, are vessels of lead, containing, suppose, two quarts each. *o p*, two cocks, each of which passes through two pipes, opening one and closing the other.

other. *q r*, a water-balance, moving on its centre *s*, and turning the two cocks *o* and *p* alternately. *t u* and *w x*, two air pipes of lead, one quarter, or half an inch diameter within. *y z*, *y z*, *y z*, water pipes, one inch diameter.

The pipe *b c c* is always full from the stream *a b*; the small cisterns *g i l*, and the large one *d*, are supposed to have been previously full of water; then admit water, by turning the cock *o*, through the pipe *c e* into the large cistern *e*. This water will press the air, which was in the cistern *e*, up the air-pipe *w x*, and will force the water from the small cisterns *g i l* into the cisterns *h k* and great C. At the same time by opening B, the water and condensed air which previously existed in the large cistern *d*, and the small ones *f h k*, is discharged at B. After a time the water-balance *q r s* closes the cocks now open, and opens their antagonists; and the cisterns *f h k* are emptied in their turn by the force of the condensed air from the cistern *d* as the water enters into it from the pipe *b c*.

Account of Submarine Mines in Cornwall.

By Mr. HAWKINS.

THE following paper is presented to our readers as preparatory to another, which we hope soon to publish, relative to a work of great public interest, now going forward, we mean the opening of a passage beneath the bed of the river from the London Docks to Redriff.

It will be here seen how works of a similar nature, and much more difficult to execute, have not only been already done, but in fact are in some degree common, in other parts of this kingdom; and that the opinion which some

some hold of the impossibility of the above undertaking being compleated can only proceed from not knowing these circumstances.

The mine of Huel-Cok, in the parish of St. Just, in Cornwall, which descends eighty fathoms, extends itself forward under the bed of the sea beyond low-water-mark. In some places the miners have only three fathoms of rock between them and the sea; so that they hear very distinctly the movement and the noise of the waves. This noise is sometimes terrible, and of an extraordinary loudness; the Atlantic Ocean having here many hundred leagues breadth. In the mine the rolling of the stones and rocks over-head, which the sea moves along its bed, is plainly heard; the noise of which, mixed with the roaring of the waves, sounds like reiterated claps of thunder, and causes both admiration and terror to those who have the curiosity to go down.

In one place, where the vein was very rich, they searched it with imprudence, and left but four feet of rock between the excavation and the bed of the sea. At high water the howling of the waves is heard in this place in so dreadful a manner, that the miners who work near it have often taken to flight, supposing that the sea was going to break through the weak roof, and penetrate into the mine.

Dr. Stukeley relates, that a coal-mine at Whitehaven is advanced so far under the sea, at a depth of 150 fathoms, (a depth greater than that of any part of the Channel between England and Ireland,) that vessels pass over the heads of the miners. Between the mine and the sea there is a considerable mass of matter.

A very wonderful circumstance at Huel-Cok is, that in some places, under the bed of the sea, where there is

only a small thickness of rock between the mine and the sea, in one place not more than four feet, there does not enter into the mine but a very small quantity of water by leakage: when the miners perceive any chinks, which might give it a passage, they stop them up with clay, or with oakum. The like method is used in the lead-mines of Para Zabulon, which also run under the bed of the sea.

The mine of Huel-Cok has been abandoned for about fifteen years past, on account of the danger which continually became more menacing.

But a work much more enterprising than any related, was one executed in the midst of the sea itself, near the port of Penzance, in Cornwall, about a century ago. At low water in this place, a gravelly bottom was left bare, in which was discovered a multitude of small veins of tin ore, which crossed each other in every direction. The adjacent rock also contained this mineral in considerable quantities: they worked this rock whenever the sea, the time, and the season would permit, until the depth became too great.

There is nothing known more of this mine to any certainty till about fifteen years since, when a poor miner in the neighbourhood undertook the work anew, and continued it with a degree of intelligence and perseverance which cannot be sufficiently admired. Before relating the plans which he formed, and the success with which he followed them, I will endeavour to give some idea of the difficulties he had to conquer, and of the obstacles which nature seemed to oppose to him.

The place where the tin ore is found is in the midst of the sea, about 200 yards from the shore; and as the bank of the sea in this place is very steep and high, this distance is not less considerable at low water. This place

is

is covered by the sea at high water six yards deep; and as the bottom is very gravelly and full of rocks, the waves become much agitated, and rise to a great height, when the wind blows from particular points. This inconvenience takes place all the winter, and has always caused the failure of the different attempts which have been made before to erect engines to drain the mine and raise the ore. At low water the rock rises a little above the surface of the sea; nevertheless, there is not ten months of any year in which it is uncovered.

Against all these difficulties a human creature had to contend, whose whole property was not worth fifty crowns. This courageous miner employed three summers in sinking a pit, during which time he could only work two hours a day, and every time when he went to work found his excavation full of water. This he was obliged to empty out before he could touch the work, which occasioned still greater difficulties when he set about blasting it.

At first he had only need of strength and patience; but when he sunk to a greater depth he added to them ingenuity. He built round the mouth of his pit a turret of wood impervious to water, and by this means was able to prolong the time of working on the rock. He farther endeavoured to shut out the sea entirely from his pit, by raising the turret above the greatest height to which the sea could reach.

But here he had new difficulties to conquer; first to make this turret impervious to water, and secondly to stay it in such a manner that neither the flux or reflux of the sea, or the shocks of the waves could overturn it: the enterprising miner had provided against these difficulties; by good chance the rock was a porphyry, not too hard to cut, but still very firm. He shaped the portions

tions he separated from it, and disposed them in a regular manner, at the bottom of the turret, and closed and calked with oakum and fat cement all the interstices between the wood and the stone, so that the whole was united into one mass. The pit, like all those in Cornwall, was lined with planks; all the joints were well calked and payed with pitch. When his frame-work was thus raised, he supported it with iron braces. He formed then about the mouth of the pit, so raised, a platform of planks, which rested on four great piles, and fixed on it a windlass, worked by four men.

This work, as may be imagined, took much time, and met with many mishaps in the execution; but the perseverance and presence of mind of the undertaker conquered all obstacles. When the pit and tower were finished, he then reaped the fruit of his industry, and established a regular work at *Stokwork*, drew from it in a little time a considerable quantity of tin, and put his adventure on a very good footing.

But sometimes this undertaking was not in such a good state. To save expense, and diminish his labours, he attacked the part of the mine overhead; by which means at high water the sea penetrated through the chinks of the rock, so that he was obliged to sustain the roof, which was extensive, in some parts, by planks and thick props, to prevent the great mass of water, which pressed on it above, from driving it in. Besides this, notwithstanding his pains and endeavours, it was not possible for him to keep his wood-work water-tight in the winter; and when the sea was rough he could not transport the ore ashore in his boat. He was forced to desist from the work all the winter, but resumed it in April. In the autumn of 1790 the chamber excavated in the inside of the rock had the following dimensions.

Greatest

Greatest depth - - - - - - - - - -	36 feet.
Depth to the level of the passage - -	26
Greatest diameter of the chamber - -	18
Least diameter - - - - - - - - -	3

Four men in two hours emptied the pit of water by the windlass, at the rate of four tons in a minute; towards the end of which time six men drove it from the bottom of the pit, and poured it into the passage. After drawing off the water they worked six hours more on the rock. From one tide to another they raised about thirty sacks of ore, each sack containing fourteen gallons; fifteen sixteenths of which were so rich that they produced one-sixth of a hundred weight of tin, and one-sixteenth of a hundred was procured from the remaining part; so that in six months they raised to the value of 600 *l.* sterling of tin. As most of the ore was interspersed in a hard rock, difficult to pound, the undertaker had it roasted in a common lime-kiln, which answered perfectly well. There was nothing of this kind done in Cornwall before.

What I have related is what I myself saw of this singular work, which is known by the name of *Huel-ferry*. One of my friends, who is in that part of the country, wrote me as follows, in 1792.

"We have hopes that the work on the vein of ore mixed with porphyry will become hereafter very profitable. It is found on both sides of the pit for a great extent; the old work is still continued, and the mine is still rich. A house near the shore, built of stones collected on the beach, and with the fragments from the top of the vein, is going to be thrown down, on account of the abundance of tin contained in those stones. One of the agents told me that in the last summer they raised 3000*l.* worth of the ore."

In

In another letter, the same person writes, "They are constructing a steam-engine on the shore opposite the mine: a wooden bridge serves to go to the rock, till the pit of the steam-engine and the adit from it, which they are going to run to the mine, are finished."

The extraordinary man who conceived and executed the work, I have related, died in the winter of 1791, aged 70 years.

Experiments made on a large Scale on the melting of Iron in a Reverberatory Furnace. By G. A. LAMPADIUS, *Professor of Metallurgy and Chemistry at Freyberg.*

From the JOURNAL DES MINES.

I SHALL first give a description of the reverberatory furnace. It was composed of three principal parts: 1, the flue and the ash pan; 2, the furnace itself; 3, the hearth and chimney. In order to produce a requisite degree of heat, the air was conducted by a vertical pipe, several ells in length; the inferior aperture of which was above a current of water, and consequently led a fresh and condensed air to the body of the furnace. The combustible employed was wood. The bottom of the furnace presented an oval receptacle, capable of containing between three and four quintals of metal. The flame, which passed with rapidity through the furnace, afterwards escaped by a chimney eight ells in height. The furnace had an aperture, which might be closed at pleasure by means of an iron handle. There was another, a few inches square, above the body of the furnace, made for the purpose of introducing the nozzle of a pair of bellows, or the neck of a retort.

In

In using this furnace I had occasion to remark very distinctly, that in the flame of a reverberatory furnace, when closed, there are always a multitude of oxydated particles of carbon, which communicate to it the property of reduction or disoxydation. This opinion I had already expressed on the subject of a memoir by M. Dacamera. In some of the experiments we made use of deal, and we observed that the smoke which issued from it was black and thick, and it possessed those qualities in a higher degree, in proportion to the freshness of the wood employed. But as soon as we made use of the bellows or the blow-pipe, the flame appeared to be clear; because then the oxygen carried along with the wind or vapours, oxydated the carbon which was in the flame, and thus produced a stronger heat.

First Experiment with the simple Fire of the Furnace.

The furnace having been heated for some hours, and the fire being very violent, about three quintals of metal were put into the reverberatory furnace. This metal when hard was grey, and had a fine grain. In an hour, a scum like scoria appeared on the surface of the melted mass, which, to judge by its appearance, consisted principally of carburet of iron. We tried to remove it, but as we found that we took away at the same time some of the metal which adhered to it, we desisted. Soon afterwards, the furnace being closed, we heard a continual bubbling, like that proceeding from a viscous matter when boiling in a close vessel. On opening the furnace we accordingly saw that the whole substance was in a state of ebullition, and that bubbles were constantly rising to the surface, where they burst with a beautiful blueish flame. These flashes had the colour exhibited by carburetted hydrogen gas. The bubbling continued as long

 as

as the fire was kept up; and from time to time a great quantity of scoria was formed, but it could not be removed on account of the viscous consistency which the metal now assumed. Besides, as the melted mass was frequently stirred in order to present a new surface to the air, the scoria was mixed with it by that operation. At the end of five hours it ceased to be fluid, and seemed to be refined. It had lost its grey colour, and the fineness of its grain. It was now white with a coarser grain, and appeared to be more malleable, but nevertheless could not be forged. The refiner put it into his ordinary furnace, where it was refined in less time, and with less trouble, than the common metal.

As it had been found impossible to separate the scoria in this first experiment, and as no alteration was made in the form of the ordinary refining-furnace, which might have been done, nothing positive can be affirmed relative to the practical advantage of refining by means of reverberatory furnaces. We were simply convinced of its possibility, and were enabled to demonstrate the theory of that operation; that is, we obtained a clear insight into what passed while it was performing. The melted mass was converted into iron by means of the oxygen, contained in the small quantity of atmospheric air, which (jointly with azote and carbonic acid gas) covered the surface of the melted matter. This oxygen united with the carburet of iron, upon which carbonic acid gas and oxyd of iron were formed, and it was this that produced the bubbles of air and the scoria. The lightness of the frothy scoria that rose to the surface at the beginning was the reason of its separation from the rest of the mass; but as soon as the air began to act, it was again destroyed.

Second

Second Experiment, in which the Fire of the Furnace was aided by the Vapour of Water.

I attempted, on a small scale, the decomposition of carburet of iron, by means of steam; by igniting the carburet the water was decomposed, and I obtained carbonic acid gas, hydrogen gas, and oxyd of iron. As the difference between the melted mass and iron consists in a certain quantity of carburet of iron which is contained in the former, and which must be separated to convert it into iron, I was desirous of trying the effect of steam on the metal in the reverberatory furnace, principally to ascertain to what degree iron may be refined in this way.

About three quintals of metal, of the same kind as that used in the preceding experiment, were put into the reverberatory furnace. Into a large tubulated retort was poured eighteen or twenty pounds of water; to the neck was adapted a gun-barrel, the end of which entered the small aperture of the furnace. This water was made to boil in such a manner that the steam was diffused with the flame over the melting metal. In half an hour all the characters of refining, which had been before remarked, manifested themselves; the bubbling was more considerable, and the flame that escaped at the chimney was brighter. Two hours after the commencement of the operation the retort was replenished with water. About the fourth hour the metal began to thicken; at its conclusion it presented all the characters of refined iron, and we imagined that the operation was finished. We, however, found the grain of this iron much finer than that produced by the preceding experiment, and the mass was full of holes, occasioned by small bubbles.

We delivered it to the refiner, who treated it in the same manner as the preceding; but what was our astonishment to find, on its being exposed to the fire, that it required more labour and longer time by an hour than the metal the most difficult to be refined.

Having tried a specimen in the state in which it was taken out of the reverberatory furnace, I found that it contained a greater quantity of oxygen. Experience had previously taught me, that half a pound of grey metal, treated in a retort with four ounces of chacoal, (purified of carbonic acid gas,) yielded 32 cubic inches of carbonic acid gas. A like quantity of white metal gave 165 cubic inches of the same gas. Four ounces of the metal of this second experiment mixed with two ounces of charcoal gave 96 inches, and consequently half a pound would yield 192.

Hence the proportions between the quantities of oxygen contained in these different kinds of metal, were as follow:

In iron super-refined with steam - - -	192
In the ordinary white metal - - - -	165
In the grey metal - - - - - - - - -	32

To the iron produced by the experiment just described I give the epithet of super-refined, (or surcharged with oxygen,) because I imagine it to be formed in the following manner. The steam is decomposed, and destroys the carburet, as the atmospheric air does in the ordinary method of refining; but at the same time this water communicates to the iron so great a quantity of oxygen, that in the refining it must not only separate the scoria, but likewise disoxydate the metal. This experiment, besides, confirms the property possessed by iron of being oxydated at different degrees. If it has produced no advantage

advantage to the practical part of the science, it has at least added to our knowledge of the properties of the metal.

Third Experiment, in which the Fire of the Furnace is aided by the Action of the Bellows.

The same furnace was used as before, and the retort employed in the preceding experiment was replaced by a double bellows, five feet long, three broad, and the posterior extremity of which when open was four feet in height. It was placed in such a manner that the current of air should be parallel to the flame, and in the middle of the furnace. The bellows worked at the rate of eight or ten strokes a minute. The object of this experiment was to ascertain to what degree the air thus supplied would contribute to the refining; the furnace was arranged and filled as in the preceding.

In half an hour it was perceived that the heat was much stronger than in the first and second experiment; the phenomena of refining, which have been already mentioned, immediately afterwards manifested themselves. But instead of the frothy scoria obtained in the first experiment, a stratum of very fluid scoria was formed, which, spreading over the whole surface, prevented the refining. These scorias when hardened had a dark brown colour, and a fracture similar to glass. More than one attempt was made to remove them, but the stratum was so thin that it was impossible to succeed; as soon as one was taken away another was formed. At the expiration of four hours, the iron being still very fluid, it was stirred, in order to bring the different parts successively into contact with the air. The result was an extraordinary heat in the furnace, together with a combustion and a scintillation similar to that which takes place when a steel

steel wire is burned in oxygen gas. This oxydation produced fresh scoria; as soon as the stirring ceased all became quiet again, and the stratum of scoria put a stop to the oxydation as before. At length, after three hours more, during which the melted mass was several times agitated, it appeared to thicken. As we perceived that it likewise diminished considerably in quantity, the fire was extinguished, and the matter in the furnace was suffered to cool. Being then weighed, it was found to have lost considerably in weight. Its extraordinary fracture had before led me to suspect a high degree of oxydation; instead of being grey and granulated, it was white like silver, and compact. It was covered with a great number of spherical cavities, of greater or less magnitude, which evidently announced the existence of a gaseous matter, the disengagement of which had taken place during fusion.

This mass was too small to be refined. Having examined the quantity of oxygen it contained, in the same manner as I had done with the metal produced by the other experiments, I found that four ounces yielded eighty-seven cubic inches of oxygen gas; consequently only nine less than that which had been treated with steam. Thus, in all probability, the oxydation was in this instance too violent, and the iron super-refined. As the metal in the course of the operation did not become viscous, it must have been super-saturated with oxygen, without passing to the state of iron; the carburet, it is true, must have been totally destroyed during the operation, and this must have produced the silvery colour.

Extract from a Memoir on the steeping of Wool, and the Influence of its different States on Dyeing. Read to the National Institute by J. L. Roard, *Director of the Dyeing Establishment in the Imperial Manufactories.*

By M. Bouillon Lagrange.

(Concluded from Page 225.)

THESE experiments, by demonstrating that the grease and the potash, which is one of its component principles, increase or decrease in the Merinos, according to their state of health or of disease, enable us likewise to form a judgment of the immediate relation of this substance to these different states, as also of its influence on the beauty of their products. For it would be a great mistake to look upon it as prejudicial to them, when we know that the augmentation of this secretion is incapable of altering the health of the animals, which were the subject of the excellent observations of Messrs. Gilbert, Tessier, and Huzard on the growth of long wools; and when the most celebrated naturalists agree in rejecting every method tending to deprive them of it, such as exposing them to long rains, and washing their backs. Besides this, does not the Merino, which is the most distinguished of all the species of this genus for the fineness and the beauty of its rich fleece, yield the greatest quantity of grease? and do we not see this substance diminishing with the quality of the wool, and dwindling to nothing in those of the same species that are covered with hair, as the sheep of Guinea and Senegal?

M. Roard, not having yet a sufficient number of facts to decide this important question, intends to consider it more in detail, in prosecuting this comparative examination of the wool and grease of sheep of various species, and in different states of health and disease.

As

As he cannot at present give his observations all the latitude of which they are susceptible, he hastens to make public the experiments relative to the effects produced in dyeing by the different qualities of the wools he employed.

The colour assumed by wools while steeping appeared to him a fact so interesting, that he thought it necessary to investigate the cause. He alternately changed the vessels and the agents destined for this operation, and ascertained that this coloration ought to be ascribed entirely to the action of copper; for ammoniac forms a blue precipitate in steeping vessels of that metal, while the same precipitate is extremely white if vessels of earth, porcelain, or even tin, be employed.

Wool that is left for some hours in boiling water, in a copper vessel, acquires a greenish-grey tint; but this effect is greatly augmented by the ordinary mixture of alum and tartar. If into this bath, saturated and boiling, you plunge different kinds of combed wool, those produced by the native breed of France and Holland assume a lively green colour, and those of merinos a greenish yellow, or a very dark ochre yellow. Though this effect is much less perceptible in steeps on a large scale, yet by comparing white wool with that which has been steeped, the difference appears sufficiently striking. The colour fixed by this method is very little altered by alkalies, and not at all by acids, which in a slight degree heighten its intensity; ammoniac turns it to a yellowish grey.

For these experiments the author employed alum manufactured by M. Curaudau, which appeared to him to possess all the qualities and defects of Roman alum, in a comparative investigation, which he undertook relative to the effects in dyeing of all the kinds sold in the shops.

The

The wools after remaining eight days in the alum-bath were then dyed with cochineal, madder, Saunders wood, &c. The same qualities, whether natural or acquired, having appeared to act in the same manner, in all the experiments to which they were subjected, M. Roard describes only the first, which was that made with cochineal.

Experiment I.

No. 1. *Healthy Merinos.*

A beautiful carnation red, inclining a little to yellow. This No. 1 surpassed in depth and intensity all the shades which he tried of more than two or three colours.

Experiment II.

Nos. 2 and 3. *Animals dead and diseased.*

The colours almost always the same; sometimes, however No. 3 is less highly coloured. The difference between these wools of dead and diseased animals and those of healthy sheep, through both of the same flock, is very remarkable.

Experiment III.

No. 4. *A Mixture of equal Parts of 1, 2, and 3.*

The quantity of the altered wool being much greater in this experiment, the colours I obtained with it nearly resemble those of 2 and 3, but never equal in beauty that of No. 1.

Experiment IV.

No. 5. *The same Wool as No. 1, but spun without Oil, and cleared of the Grease at a single Operation.*

The colour produced by this wool was more brilliant than that of No. 1, but its tone was less high; which demonstrates that in some operations the natural colouring matter must be of some utility. Thus in fine crimsons,

and some other colours, the silks ought to retain somewhat of their rawness, for those that are white can never acquire the same appearance. This observation perfectly coincides with the experiments of Collomb on the good effects in dyeing of silk still charged with a portion of its colouring principle.

Experiment V.

No. 6. *Clippings of Wool of Picardy.*

The deteriorated matter, which forms a part of this wool, takes the colour so ill that it can never be equal; in all the experiments it invariably produced a dull dirty colour, far inferior to that of No. 1. By the mixture of this damaged wool the dealers adulterate the quality of all the carded wools of France, which, as much preparation agrees very ill with them, can be employed only in the manufacture of the most ordinary stuffs.

Experiment VI.

No. 7. *Clippings and Wool of the Merinos No. 1, in equal Parts.*

Notwithstanding the bad quality of the wool No. 6, this mixture took the colour so well, that, in all my experiments, it was not much inferior to that of No. 1, though owing to the clippings its appearance was always dull.

Experiment VII.

Nos. 8 and 9. *Mixtures made with equal Parts of Clippings, the Wool of dead Animals No. 2, and of diseased Sheep No. 3.*

The difference between Nos. 8 and 9 was scarcely perceptible; the colours were dull and dirty, and darker than Nos. 2 and 3, of which they were in part formed.

Experiment

Experiment VIII.

I dyed blue the same numbers of wool employed in the preceding experiments, and their results perfectly agreed with those already stated. This colour is perhaps the only one that wools of an inferior quality take well, though the blue is not equal, and always inclines to black.

Experiment IX.

The wools, No. 1 and No. 2, which had been scowered and the scrapings, No. 8, were treated with the dye, comparatively with that of No. 1, spun in the grease. The three first took the colour slowly, and assumed a dull blue tint, inclining to black. No. 1, on the contrary, took it very speedily, and acquired a beautiful and very deep blue colour. These four numbers were scowered together hot, with Flanders soap; the wools of the healthy and dead animals and the clippings entirely lost their colour, while that of No. 1 in the grease retained a very brilliant barbel blue.

Experiment X.

Wool of the three qualities employed in the three manufactories of tapestry, were dyed at the same time with the Merino wool, No. 1. In all the experiments the latter took a deeper colour than any of the others which are carded wools of Flanders, Holland, and Picardy.

The principal facts contained in this memoir lead us immediately to the following consequences:

1. In scowering, the heat of the bath ought never to exceed 60°, for even before it rises to the temperature of boiling water wools in the grease are very liable to be injured by the potash.

2. Wools scowered at two operations can never be rendered completely white. This effect seems to pro-

ceed from a change of state in the greasy colouring matter, which, by becoming more highly oxygenated, loses its solubility.

3. Oxygenated muriatic acid, and oxygenated muriatic acid gas, precipitate, in white flakes, the animal matter contained in the grease: it is speedily coloured by the air, and contains a substance with an agreeable smell, which appears to be perfectly analogous to that developed by ammoniac, and with that discovered in it by the antients.

4. We ought to be the less surprised to see the quantity of potash and of grease diminish or increase in sheep, according to their state of disease or of health, as a secretion so complicated, requiring the utmost exertioirs of nature, must invariably be intimately connected with the augmentation or diminution of the vital powers. But how is it possible to doubt that the grease has an immediate action on the quality of the wool, when we see those two substances proceed, if we may so express it, in harmony, from the wild sheep of Greece to the most beautiful and the most vigorous Merinos?

It was doubtless to assist them to recover this precious transpiration, that the Romans, after shearing, covered them with a mixture of tonic and oily substances, which, according to Columella, preserved them from many diseases, and contributed to render their wools finer and longer.

5. I have demonstrated that these wools constantly assume, in copper vessels, solid colours, more or less deep, which, even at the lowest degree of coloration, prevent them from taking the first shades of a tint. This effect is obviated by the use of tin vessels, the oxyd of which cannot alter the whiteness of the wool during steeping.

6. All

6. All my experiments in dyeing prove that the affinity for the colouring matter varies in wools according to the healthy or diseased state of the animal; and that the wool of healthy Merinos is always more highly coloured than not only Nos. 2 and 3, though the produce of the same flock, but even than all the carded wools of France and Holland. They shew to what causes we ought to ascribe the effects produced on wools, the exterior characters of which are perfectly alike, and which, after receiving the same preparations, assume, in the same bath, different colours.

7. The beautiful and very solid blue colours, which I have obtained from wools in the grease, demonstrate, in a very positive manner, the influence of that animal matter, which, if transported to other substances, might furnish the arts with many highly useful applications.

Observations of the Author.

Since my Memoir was read to the National Institute, we have received a complete proof of the facts to which I ascribe the variations exhibited in dyeing by carded wools. Having ascertained that the different causes which exercised an influence over our operations could not arise from the manipulations of the dyer, we complained to our wool-merchant of the bad quality of his goods. He was then obliged to acknowledge that he mixed the wools of Flanders with those of Holland according to the general practice of the trade; and that, though all the dyers had constantly complained of the same defects, yet, as they had neglected to acquaint him with the cause, he had not been able to take such measures as to prevent them in future. These wools are likewise attended with a disadvantage of another kind, which it is of considerable importance to indicate; I mean

mean the augmentation that is given them by passing them through butter-milk, and which almost always amounts to one-eighth of their weight. They are surcharged with a white dusty matter; which, even after careful and repeated washing, still furnishes a sufficient quantity of acetous acid to change a great number of results in dyeing.

Observations on giving a curved Form to Wood.

Extracted from a Treatise on Carpentry, by J. H. Hassenfratz.

With an Engraving.

The curved form may be given to wood either growing or cut; the processes to be employed differ according as it is in one or the other of these two states.

Of the curving of growing Wood.

Growing wood possesses a natural elasticity, which varies according to its nature, its dimensions, and its age; the thicker and the more aged, the less elasticity. Growing wood is bent to prepare and give it a form suitable to the use that is intended to be made of it when cut. In this manner trees may be bent before hand which are destined to be employed in ship-building, or in making the fellies of wheels of a single piece.

When trees are young and tender their stems may be bent either by cords, or by poles, stakes, or frames. They are kept in this situation so long till they retain the curvature that is intended to be given them, even when disengaged from the obstacles by which they are held.

Of

Of all the methods of bending trees that applied to young and growing wood is the most easy and convenient; their suppleness and their elasticity admit of their assuming any form that is desired. There are few, to which with proper care, and the necessary precautions, you may not give the most singular forms; but, it is true, their whole system is thwarted, their vegetation is retarded, and they are often reduced to a state of constraint and disease prejudicial to their growth.

Of giving a curved Figure to Wood after it has been cut.

The curving of wood after it has been cut, though more difficult, is, however, more customary, because such pieces may be selected as are the best adapted to the objects for which they are intended, and a suitable curvature may be given them immediately.

The process generally employed is founded on the property possessed by caloric of augmenting the elasticity of wood by penetrating it, and of diminishing its elasticity when it retires.

Accordingly, to give a curvature to thin pieces of wood, such as pipe-staves and the planks that cover the sides of boats, they are heated in the part where the curve is required, and they are gradually bent as they become hot.

But caloric applied to a particular portion of the wood while the other is in contact with the air, heats it unequally, and produces only a partial augmentation of the elasticity: in curving, some parts become stiff and others bend, which produces an inequality of curvature, and sometimes cracks in the interior, and splinters on the surface of the wood. The only method of correcting this inequality is to heat the wood alike in every part.

Ovens

Ovens and stoves, gradually heated, are proper for procuring an equal heat, and consequently for facilitating the curvature of the wood; but here great care must be taken, lest, in heating the wood, the caloric should disengage the liquids contained in it, lest it should carbonize it, and totally destroy its elasticity.

The elasticity of wood is in proportion not only to its temperature, but likewise to its humidity. At an equal temperature the same pieces of wood have different degrees of elasticity, according to the quantity of water by which they are impregnated; in the same manner as, with an equal degree of humidity, they are the more elastic the more they are heated.

We have an example of the two-fold influence of humidity and of caloric in putting together two pieces of wood, as the tenon and mortise, in which the mortise is only one-third of the size of the piece that is to go into it. This manner of joining, apparently so extraordinary, is considered such an important invention, that most of those by whom it is practised keep the method a secret. It was the process employed in producing this effect that produced the method now employed for curving with facility the thickest and most obstinate pieces of timber; the whole art consists in impregnating the pieces of wood with humidity, by procuring them an uniform temperature, then to bend them, and suffer them to cool, in the form they are intended to assume.

To heat and to impart humidity to wood, three different processes are employed: the first is by boiling water, the second by steam, and the third by wet, heated sand.

The stove for boiling water is composed of a large copper, heated by three furnaces, and covered with a moveable lid; its dimensions vary according to the wood that

that is to be put into it. Cranes turning on a pivot are employed to raise the wood to put them into the copper, or to take them out of it. The copper is always kept full of water. When the wood is introduced, put on the lid, to diminish the vaporisation of the water; by the action of the three fires the water is made to boil, the wood becomes heated and impregnated with humidity, and it is taken out to be curved.

This process, one of the first that was employed, is attended with the inconvenience, that the boiling water dissolves part of the substance of the wood; at least, on drying again, it shrinks both in thickness and in length; its strength and its elasticity are considerably diminished. These considerations have caused this process to be relinquished.

Figs. 2, 3, 4, (Plate XV.) represent the plan and elevations of a vapour-stove. This stove is composed of a great chest of wood, formed of thick planks, firmly joined together. Within it are supports, on which to place the wood that is intended to be submitted to the action of the vapour.

The dimensions of the chest depend on the magnitude and the quantity of the wood that it is designed to mollify.

For small chests place a boiler at one of the extremities; the wood is introduced by a door that slides or opens on hinges at the other. In large chests the boiler is placed in the middle, and the wood is introduced at both ends. Apertures *a a a* are made on the side opposite to the boilers; these apertures serve to arrange the pieces on their supports. It is customary to leave the exterior of the chests exposed to the contact of the air, but it would be more advantageous to cover the planks with matters

which are non-conductors of heat to retain that which is disengaged by the vapour in the interior of the chest.

As the boilers communicate in the interior of the chest by means of a pipe, the vapour is conveyed to each story by tubes *b b b*, Fig. 4. The vapour formed by the ebullition of the water impregnates the wood with humidity, augments its elasticity, and renders it fit to be curved.

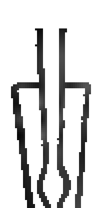
The vapour-stoves require little care or expense; but they can be used only for planks of a certain thickness; because wood cannot acquire a higher temperature than that of boiling water, and because this temperature is not sufficient to give thick pieces the elasticity they require in order to be curved.

It was this low temperature that led to the invention of the sand-stove. This kind of stove is formed of four walls of stone or brick. In the middle are two fire-places, which have a communication with several circular flues, to convey the caloric, the heated air and smoke, to the two chimnies at each end. Over these flues are plates of metal, forming the bottom of the chest in which the sand is put. The flame and the smoke circulating in the flues, heat the plates by means of the caloric which they disengage, and which communicates heat to the sand. This stove is an imitation of the sand-baths, which have for a very long period been employed in a great number of chemical operations, and in various manufactures.

As sand is capable of being heated to a much higher temperature than boiling water, the wood placed in this kind of stove may be subjected to a much more powerful heat: but if there was nothing in the stove but the sand and wood, the heat might disengage from the latter the gaseous substances which compose it, and convert it into charcoal.

To

Fig 2.



To prevent this carbonisation, one or two boilers filled with water are placed in the middle of the stove. The steam created by their ebullition impregnates the sand with humidity. This humidity likewise penetrates the wood, and the caloric with which the wood is impregnated evaporates only the water which is continually supplied by that which is disengaged: by these means the constituent parts of the wood are preserved.

It cannot be denied, that in this operation some portion of the component parts of the wood are evaporated, and that it is consequently liable to a commencement of deterioration: but if care be taken to remove the wood to be curved as soon as it is sufficiently heated, and impregnated with humidity, the injury is imperceptible.

The sand-chest or stove is covered throughout its whole length, to retard the evaporation of the gasified water it contains, and to permit the caloric to accumulate in quantities sufficient to give the wood the necessary temperature.

The pieces of wood are introduced into the stove at the two ends, and are placed on gratings fixed to receive them. They are put lengthwise into the stove, and are covered with sand.

When the wood is heated, and impregnated with humidity, to a degree proper for giving it the curvature required, it is bent on outlines making this curve. It may be bent in two ways, either horizontally or vertically. The former method is applicable to wood of no great thickness, and the curvature of which is more considerable.

In both of these methods the force which determines the curvature acts by means of cords, pullies, and even by capstans. The piece should be kept in the form it is intended to take; and by leaving it in that state, to be-

come cool and dry, it is made to retain the curvature that has been given it.

When the piece of wood is not thick, it is frequently the case that the pressure produced by men, or even by weights, is sufficient to give the necessary curve, and to preserve it while cooling.

The methods of giving a curved figure to wood may be varied in an infinite number of ways according to its elasticity, its dimensions, its temperature, and its humidity.

On a Colour for marking the Ends of Cotton or Linen Cloths, capable of resisting the Operations of bleaching, and likewise the most complicated Manufacture of printed Cloths, without extending beyond the Limits of the original Impression. *By M.* HAUFFMAN.

From the ANNALES DE CHIMIE.

TO produce a colour proper for marking cloths of every kind, it is necessary that no substance or drug dissoluble in alkaline leys should enter into its composition. It is equally indispensable that the substances intended for any composition whatever should not turn white when combined with oxygen; and that they should remain indissoluble in acids, of the strength required for bleaching, as well as for the preliminary operations in the fabrication of printed cloths.

Colours composed with drying oils cannot therefore, in my opinion, be employed for this kind of marks, because they are not only liable to be attacked by alkaline and saponaceous leys, but because in drying slowly they run, and very often occasion spots.

If

If colours composed with spirit-varnish were even not attended with the inconveniences of speedy evaporation and desiccation, still they could no more be employed than the preceding, because turpentines and resins are very easily transformed into soap.

Nor can gum-copal be used for colours for marking, because it is detached from the stuff by mere ebullition in water: but as the varnish I have made with it preserves copper, as well as vessels of any other metal, from the action of acids of a certain strength, I thought the detail of the process for making it would not be misplaced here. To obtain from copal the above varnish of a whiteness and transparency resembling water, it is necessary to employ copal reduced to a very fine powder, and to expose it with twelve parts of fine oil of turpentine for some hours, or till it is completely dissolved, to the moderate heat of a sand-bath, in a capsule of glass, stone, or porcelain: observing to stir the whole very often with a glass stick. It is at the moment when it begins to acquire the consistence of syrup that the total dissolution of the copal takes place by means of the stirring, which is facilitated by the occasional addition of a small quantity of oil of turpentine to replace that which evaporates. Three-fourths of the oil of turpentine which are lost by the evaporation in open vessels may be saved by effecting the dissolution in a long-necked matrass, exposed to a sand-bath, a sufficient time to complete the dissolution of the copal, shaking it at the same time very frequently. The varnish obtained by one or the other of these methods turns of a yellowish colour if the heat be too violent, and as its application would be difficult when its consistence too much resembles that of honey, it is adviseable, instead of diluting it with oil of turpentine, to mix it with one-fourth or one-fifth of its weight of alcohol, taking care not

not to put more than is necessary, for an excess would turn it to a milky-white by the precipitation of part of the copal which admits into solution with it only a certain quantity of alcohol without being precipitated. Vessels of copper, or of any other metal, may receive one, two, or three coats of this varnish, and ought each time to be thoroughly dried in an oven; after which they bear extremely well to be washed with boiling water, and are capable of resisting a heat of a still more elevated temperature without losing the varnish; but at all events care should be taken not to rub the vessels with sand, or any other hard bodies.

By means of oil of turpentine which evaporates and dries less speedily than alcohol, I have succeeded in obtaining a black composition, which to me appeared capable of being used with advantage for marking cloths. The method of making it, is simply to dissolve slowly in oil of turpentine, in a sand-bath, continually stirring it, a quarter of its weight of asphaltos, or bitumen of Judea, broken into small pieces, and afterwards to mix with it as much as possible of lamp-black, or black produced by any mineral substance whatever, highly coloured, and in very fine powder, either carburet of iron, sulphur of lead, or any other. This colour will be obtained more or less thick, according to the proportions of the oil of turpentine and bitumen; it will mark exceedingly well without running, observing the just proportions, and diluting it with a new portion of oil of turpentine, if while it is in use it acquires too much consistency. This bitumenous colour bears equally well the action of alkaline leys and of oxygen, and resists all acids of a certain strength.

Finding it unnecessary to continue the trials of oily colours, I undertook the aqueous experiments in the following order.

Experimen

Experiment I. In four ounces of water I dissolved one ounce of sulphate of manganese, without water of crystallization, and such as is obtained by procuring the oxygen gas of the black oxyd of manganese, by means of sulphuric acid, and by increasing the violence of the fire towards the conclusion of the operation, so as to ignite the retort. This dissolution was thickened with a dram of fine gum-dragon in powder, and coloured with lamp-black, in order to be able to distinguish the accuracy of the impression, that is executed very easily with this black, saline, metallic mass, of which, however, no use can be made, excepting the ends of the marked cloths be plunged into alkaline ley, without previously passing it through water, to take away the saline matters. The ley may be made with potash or soda, in the proportion of one part of alkali to from nine to twelve parts of water; it may be used in the state of carbonate, or rendered caustic with half a part of quick-lime. The precipitation of the oxyd of manganese from marks, by one or the other of these alkaline leys, will take place (allowing for its coloration by the lamp-black) under the colour of a yellowish-white, which will gradually turn brown by the attraction of the oxygen of the atmospheric air. The alteration of these marks to brown will take place very speedily, and even with a stronger intensity, approaching to black, if you bleach by means of an alkaline oxygenated muriatic ley, the cloths, the ends of which have been plunged for a few minutes into any kind of alkaline ley whatever. These marks of brown oxyd of manganese resist not only all the processes of bleaching, and all acids of the strength required by them, but likewise the more complicated fabrication of printed cloths.

Experiment

Experiment II. If acetic acid had not more affinity with manganese than with iron, and if it were disengaged as easily from acetate of manganese as from the acetic solution of iron, by evaporation and desiccation, inalterable marks might be procured in the most simple manner, by causing the oxyd of manganese to adhere to stuffs by means of acetic acid, and afterwards abandoning that oxyd entirely to the attraction and saturation of the oxygen of the atmospheric air. The acetic dissolution of manganese may very speedily be obtained by mixing, in suitable proportions, acetate of lead with a solution of sulphate of manganese; but as this acetic solution possesses no advantage over the sulphate of manganese for marking stuffs, as it is necessary, before it can be used, to subject it in every respect to the treatment described in Experiment I. and as it is much dearer, it is not adviseable to employ it.

Experiment III. Two ounces of sulphate of manganese dissolved in eight ounces of acetic solution of iron, concentrated to twenty degrees, furnish, when thickened with one-fortieth part of gum-dragon, a deep yellow colour, which gradually turns to a brown if treated exactly in the manner described in Experiment I. The acetic solution of iron affords for the rest no other advantage, than that of causing the colour of the marks to dry rather more speedily, for the oxyd of iron dissolves more or less rapidly in acids, in proportion to its state of oxygenation or oxydation. I prefer gum-dragon for thickening marking-colours to the other gums and to starch, because those substances weaken the colours too much by their interposition; if, however, in the marking of coarse cloths, gum-dragon should be attended with any difficulties, it would then be necessary to have recourse to starch.

Experiment

Experiment IV. If care be taken, in the disengagement of oxygen gas from a mixture of black oxyd of manganese and sulphuric acid, not to push the fire to incandescence, the saline residue is blackish; but with a violent heat it turns to a yellowish white. On dissolving this residue, you separate from it by washing an oxyd of a dark grey, which acquires the consistence of paste on the filtre, when deprived of the aqueous vehicle. On mixing this grey paste-like oxyd with ever so small a quantity of water, thickened with gum-dragon, and printing with it, you obtain marks of an extremely dark grey, which dry very speedily. This grey colour cannot be removed by water, though it may not have been steeped in an alkaline ley; it is so tenacious and unalterable, that it withstands not only the action of all the acids of a certain strength, but likewise all the processes of bleaching, as well as the most complicated fabrication of printed stuffs, without attracting the colouring parts of any dye whatever.

Experiment V. If it were not for the apprehension of weakening a little the place where the stuffs are marked, equal parts of a mixture of the above-mentioned grey paste and a nitro-muriatic solution of tin, charged with one-fourth part of the metal, and thickened with gum-dragon, might be employed with advantage. This colour is equally unalterable with that of the preceding experiment, and it possesses the additional advantage of attracting by its oxyd of tin, saturated with oxygen, the colouring parts of any dye whatever, and to turn to dark brown in dyeing with madder. I shall observe on this occasion, that, by this madder-dye, the colours of marks produced by oxyd of manganese, saturated with oxygen, turn to a dark brown, approaching to black; whereas, in a state less oxygenated, they assume shades more or less

different. However, in all these circumstances, it is necessary that there should be as much metallic oxyd as possible, without which you obtain only light tints of various other colours.

Experiment VI. As many insoluble metallic oxyds nevertheless acquire the property of adhering to stuffs by means of acids, I resolved to try if the same was the case with the precipitate of manganese saturated with oxygen. For this purpose I dissolved one part of sulphate of manganese in six parts of water, and afterwards proceeding with the precipitation, to the point of saturation, with a caustic alkaline ley, composed of half a part of quick-lime, four parts of water, and one part of calcined potash of commerce, I obtained a precipitate of a yellowish white. I then added to the whole aqueous mass a sufficient quantity of oxygenated muriatic alkaline ley till the precipitate was completely saturated with oxygen, and its brown colour ceased to increase in intensity. Then collecting on a filtre the precipitate, or brown oxyd of manganese, I let it stand till, by the loss of water, it assumed the consistence of paste. This brown paste mixed with half its weight of acetic acid, as highly concentrated as possible, yielded only a weak brownish tint; and it continued the same after the addition of any of the three acids, sulphuric, muriatic, and nitric, weakened with water. I obtained a result not more favourable on mixing a part of the above-mentioned brown paste with an equal portion of acetic solution of iron, marking twenty degrees on the arĕometer for saltpetre, and thickened with gum-dragon. This acetic solution of iron, containing only the quantity of oxygen necessary for the solution of the metal, seized, by a much stronger affinity, the excess of the oxygen of the brown oxyd of manganese, which was afterwards completely dissolved in its turn; and

and from the whole resulted a mixture of solutions of two different metals, of a reddish yellow colour, very deep, and transparent: which confirms the observation, that a saturated metal requires less acid for its dissolution than if it were in a contrary state, and that, being then provided with an excess of acid, this solution, saturated with oxygen, is capable of admitting a portion of another metal without being disturbed. This mixed solution of two metals yielded me only a rust-yellow, which diluted sulphuric acid carried away entirely at the expiration of a time rather longer than that required to remove a less oxygenated rust-yellow. To obtain from these two metallic solutions a marking-colour, impossible to be effaced, it was necessary to steep the marks for some minutes in an oxygenated muriatic alkaline ley, in order to precipitate, and to saturate with oxygen, the oxyd of manganese. By the mixture of another half part of the brown paste of manganese to two parts of the solution of the two metals, this new portion remained unaffected, and disturbed the whole. This turbid mixture being thickened, yielded only a faint brownish tint on the stuff, after remaining a considerable time in diluted sulphuric acid.

By means of the muriatic solution of tin, which possesses the property of seizing the oxygen of various substances, vegetable, animal, and mineral, and which, for this reason, may be advantageously employed in dyeing, as well as in the manufacture of printed stuffs, the darkest oxyds of manganese and of iron are deprived of colour, and instantly dissolved; which demonstrates the more powerful affinity of tin for oxygen, than for manganese or for iron.

Note. No apprehension need be entertained respecting the effect of steeping marked cloths in an alkaline ley; it is

an operation which is speedily performed without any perceptible loss of potash or of soda if you first proceed to wash with ley, for which purpose that which is left may be again employed. If, conformably to the practice I have followed for a number of years, the alkalies for leys were made caustic with quick-lime, a great quantity of soda and potash would be saved, and at the same time a superior effect would be produced.

Examination, chemical and pharmaceutical, of the Products of the Grape, not fermented.

By M. Parmentier.

From the Annales de Chimie.

PREVIOUS to treating of the juice of the grape, better known by the name of must, we shall observe, that, independent of the uses to which the husks remaining in the press may be applied, such as the distillation of brandy, acetification, and the manufacture of verdigris, they possess other properties which cause them to be reserved at the season of the vintage, and recommend them either as food for beasts, or for manure, or, lastly, for a fuel capable of furnishing ashes abounding in salt. Among these husks are likewise included the pippins; from which a very agreeable oil is extracted in some countries, and which serve to fatten poultry in others.

But it appears to us, that writers have not treated with equal diffuseness, in a chemical and pharmaceutical point of view, of the juice of the grape reduced by heat to different degrees of consistence, for the purpose of forming those preparations more or less agreeable which are in daily use in our domestic œconomy.

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The antients concentrated the juices of fruits, with the design of preserving, in a small compass, all the properties by which they are characterized: but the more enlightened moderns, perceiving that the processes in use at that time were defective, have sought to improve upon them, and they have been enabled to succeed only by the addition of sugar, a substance which the discovery of the new world has rendered so common in Europe. We shall, however, see in the sequel, that it is possible, without the assistance of that material, to obtain satisfactory results. Let us first consider the substance called *Raisiné.*

Raisiné.

This name is particularly applied to a kind of very agreeable marmalade, prepared in all the vine-districts, with the juice, the pulp, and the husks of grapes, not fermented, the ripest, the most saccharine, and the most fragrant. To these various fruits, vegetables and aromatics are frequently added; but never, at least in the south of Europe, either honey or sugar. The place of those two articles, of which, as every one knows, all other sweet-meats are composed, is supplied by the mucilagino-saccharine quality of the grapes themselves, which in hot countries, and in dry years, are abundantly provided with that principle.

We should presume, that the preparation of raisiné is as antient as the art of making wine. It is described in our earliest pharmacopœias under different names; it was the sweet-meat of our ancestors; it still pleases the palates of all classes in society, and is so necessary, that in districts the most remote from the wine provinces the inhabitants make it of stone-fruits, employing for a vehicle, instead of the juice of the grape, that of the apple

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and the pear recently expressed, that is, sweet cyder and perry.

The consistence of raisiné varies from that of an electuary to that of a syrup; in the latter state it is easy to dilute it with water, to make an edulcorated beverage. It appears that the natives of the East still continue to make this kind of liquid raisiné, for M. Boudet, chief apothecary to the army of the East, found in the shops of Alexandria, earthen bottles of a pleasing form, which were full of this substance, of the consistence of melasses. It is used in Egypt for making a kind of sherbet.

Without designing to recapitulate in this place all the advantages that may be obtained from raisiné, we shall confine ourselves to the principal. We know, in the first place, that the elements of which it is composed are elaborated, combined, and mixed, so as to present all the characters of an agreeable sweet-meat, and to secure, for a certain time, from fermentation, the extract, the jelly, and the pulp of the fruits.

In seasons when stone-fruits are scarce, when the most diligent housewives are obliged to relinquish all thoughts of making a provision of jellies and marmalades, and when the weather has been favourable to the grape, the latter affords a substitute for those sweet-meats, that produces a great saving of sugar, which does not enter into the composition of raisiné, unless in wet years, in those parts of the west and north of France where the vine thrives, when the grapes are green; for we are far from thinking that sugar can, in any case, injure the quality of the raisiné. When its price was low, the addition of it was attended with no perceptible increase of expense; but being now trebled at least, and sugar being, in some measure, an exotic article for France, all the efforts of industry should tend to diminish its consumption. The raisiné,

raisiné, containing a certain proportion of it, must cease to be considered as a popular sweet-meat; it is no longer within the reach of persons of every class; people of fortune alone can afford to use it.

I know that it is in the power of art to correct the bad quality of wines, and to improve them considerably, by the addition of sugar and honey prior to fermentation, and that by this method their too great acidity may be corrected: but very fortunately, in years favourable to the vine, grapes have no occasion for this assistance. To render the use of raisiné more general, and to diminish, both for the present and the future, the consumption of sugar, is to contribute to the interest of the public and of the individual.

Choice of Fruits for Raisiné.

If all the different kinds of grapes are not fit for making wine, yet they are all equally proper for the preparation of raisiné; many of them are so abundantly provided with the mucilagino-saccharine principle, that it is absolutely necessary to add to them pulpy, sharp, sour fruits, ripe or unripe, and aromatics, to correct their too great lusciousness; whereas others, according to the climate and season, require a small quantity of honey, melasses, or powder-sugar, to moderate their excessive acidity.

Every year is not so favourable as the present to the quantity and quality of grapes; in consequence, the grape of the northern departments, in general less pleasant to the taste, is almost as full of the saccharine principle as the same kind raised in Dauphiné and Burgundy; and the raisiné that will be made of it may be kept for years. The alteration it undergoes with keeping is, that it hardens or liquefies; in the former case it is boiled down at the

the time of the vintage with new must; and in the latter, on the contrary, it is exposed for a short time to the fire. By these precautions the housewife may renew her stores, and place them in such a condition as to keep over the winter.

It is remarked that, in the southern countries, where more raisiné is commonly made than in other provinces, the grapes which are considered the most proper for this preparation are, the white muscatel, the red muscatel, and the *chasselus*. They arrive in those parts at such perfect maturity, and contain so great a quantity of the saccharine principle, that the wines obtained by the decomposition of this principle furnish upon distillation a third of their weight of a spirit abounding in alcohol.

The grapes intended for making raisiné should not be gathered till they are perfectly ripe, nor, if possible, in any other than dry weather, and warm sun-shine; particular care must be taken to separate all the stalks and the damaged grapes, as a small quantity of either would be sufficient to spoil the agreeable flavour of the raisiné.

If you continue to enjoy after the vintage some gleams of sun-shine, and have nothing to fear from the birds and insects, it would be adviseable to leave the grapes some time longer on the plant; in the contrary case, they should be taken into the house, and laid upon straw. By these means you diminish the expense of evaporation, and the raisiné, which may then be exposed for a time proportionably shorter to the action of the caloric, yields a more abundant result, less highly coloured, and of a more agreeable flavour. This advice, indeed, which I give only to housewives who are not above preparing themselves the raisiné they use in their families, cannot possibly be adopted as a rule by those who particularly study quantity and cheapness. But every master of a

family,

family, be he in whatever situation he may, can, with the assistance of a few vine stocks, obtain a yearly supply of sweetmeats of as good a quality as he pleases.

Raisiné is not always composed entirely of the juice of the grape, more or less concentrated by evaporation; other fruits are added to it, according to the local resources of individuals. Of these, the best are pears and quinces, then apples, and lastly plums; but these fruits must be sharp and sour, to qualify its too luscious flavour. The preparation of raisiné, besides, furnishes an occasion for making use of fruit which have fallen from the trees before they were ripe; they need only to be boiled to be made into marmalade, and to be preserved in that state till the vintage.

Fruits extremely saccharine, succulent, with a soft pulp, that have attained the highest degree of maturity, are not the most proper for the preparation of raisiné; they lose while boiling the advantages they possessed when raw, and after that operation appear to be decomposed rather than improved.

Pears, apples, and plums, do not always form the basis of raisiné; the rind of melons, which had not time to ripen, and saccharine roots, such as the carrot, are introduced. But it is not only the quality of the fruits, their proportion, and their state of maturity, that contribute to the perfection of the raisiné. The process employed to effect their combination has no less influence on the quality and the price; it is, therefore, necessary that this preparation, as simple as it may appear, should be methodically regulated.

Though it is a custom universally adopted in all the southern provinces, to prepare at home a stock of raisiné for the winter, yet all housewives are not thoroughly acquainted with the best process. They do not pay suf-

ficient attention to the circumstance, that grapes the most saccharine, and the least watery, require the less evaporation, and *vice versá*. Most of them make too much fire, and keep up the boiling too long, which causes it in time to become thick; others fall into the contrary extreme: in that case it becomes soft; a syrup, or a species of melasses, is separated from it, and at length, towards the conclusion of winter, it turns sour, especially when the season is mild and wet. It is therefore indispensably necessary to subject this operation to rules to which we ought to adhere as strictly as possible.

Process for the Preparation of Raisiné.

A general rule to be adopted in the preparation of raisiné, let its consistence be what it may, is to perform the process at twice, and to take care, as soon as the liquid extracted is reduced to two-thirds, to strain it off quite hot, to distribute it into unvarnished earthen pans, and to leave it in them till the following morning; then, by means of a skimmer, take off the saline pellicle which covers the surface, and decant the liquor. The crystallizations at the bottom of the vessel and on the surface are nothing but crystals of tartar, the separation of which is a medium of diminishing the too strong acidity of the raisiné prepared in the northern cantons, and is perhaps a cause of its laxative quality; for there is every reason to presume, that it is to the presence of tartar, and to the mucilaginous body contained in the juice of the grape, to which is owing the relaxing property possessed by that fluid; a property which it loses in passing into the state of wine, because the fermentation has converted the one into alcohol, and precipitated a great portion of the other with the lees.

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By thus separating from the juice of the grapes, evaporated to two thirds, the quantity of tartar, which can no longer remain in solution, you increase the strength of the sugar, which, having no acidity to correct, becomes much more perceptible both in the raisiné, in the syrup, and in the boiled wine, and the liquors prepared from it.

Another condition, necessary for rendering the raisiné as perfect as possible is, that when fruits or roots are intended to enter into its composition, both the one and the other must be carefully pared, and their pips and core taken out; and that they should not be added to the liquor till it has been brought by evaporation to the consistency of syrup, which is easily made to give, and preserves the fluidity necessary for promoting its action on the fruits, and for mollifying and combining them in such a manner as to form an equal and homogeneous marmalade.

A third and last condition is, to stir incessantly the mixed liquid, and to keep up a very moderate heat: perhaps it would be prudent to complete the making of the raisiné only at the temperature of the *balnea mariæ*, when it would run infinitely less risk of being burned.

The nature of the vessels employed for the preparation of the raisiné likewise deserves some consideration. Some have complained that the use of it has produced cholics. Supposing these complaints to be well founded, this inconvenience would be obviated by employing in its preparation nothing but vessels of brass or copper, perfectly tinned, to prevent the liquor, which always has a character particularly acid, from exercising a powerful action on the deleterious metal, and dissolving some particles of it.

Observations on the Phenomena which take Place in Raisiné.

Raisiné, like other marmalades of fruit, exhibits in its preparation various phenomena, to which sufficient attention has not been paid, because this kind of preparation has become the peculiar province of an art, which, being distinct from pharmacy, has not yet been thought worthy of profound investigation by scientific men.

The fruits of which these marmalades are composed experience remarkable alterations in taste and colour. What is the cause of this? In our opinion it must be sought in the decomposition which the constituent parts of the fruit have undergone from the action of the caloric, and the new combination they have formed with the water; a combination which, on account of its difference from the former, must produce different effects on the organs. On this subject we shall observe, that the saccharine taste of a fruit, seed, or root, is not always proportionate to the quantity of the mucilaginous sugar which those parts of vegetables contain, and that in this case an appropriation to the saccharine flavour takes place, in consequence of the mixtures and modifications produced by boiling.

If the leaves of plants lose a portion of their virtue by mere desiccation in the open air, if fruits and roots become tough and much less juicy from the same cause, we are yet authorized to conjecture that the mild heat, which has produced the desiccation of these parts of plants, has not been able to deprive them of their superabundant humidity. If cultivation is capable of giving them a new taste, what may not be expected from the action of heat elevated to such a degree as to bring into ebullition the water they contain, which then has a degree of heat superior to that of boiling water? This action necessarily

produces

produces the effect remarked; to no other cause can we ascribe the striking difference existing between culinary and leguminous plants when raw, dried, and boiled.

But how can this new combination, produced in fruits by the heat of ebullition, be altered by remaining exposed to it beyond the proper time? It shares the fate of all vegetable combinations; it is necessarily and successively subject to different modifications, in proportion as the caloric takes from it some of its principles. Hence the care necessary in conducting the evaporation of marmalades, and in boiling them, to desist at the moment when they are altered as little as possible. Thus, in refining sugar, attention is paid not to expose it to the action of too violent a fire, which would produce a partial decomposition, and increase the quantity of its mother-water.

When these marmalades are not sufficiently boiled, and spoil, with age, in a humid atmosphere, why do they turn sour, without having undergone the spirituous fermentation? The reason is this. Being destitute of the qualities without which that fermentation never can take place, or change sugar into alcohol, the movement which replaces it does not act on the sugar but on the other substances, which are more disposed to be altered in different ways. In fact, we observe that spirituous fermentation takes place in the juice of fruits only when the fluid parts, abounding in the sweet and saccharine principle, are extracted from them, and are at liberty to act upon each other with the aid of a certain degree of heat. For humidity and temperature are two causes sufficient to produce fermentation without the assistance of air and light: as we know that many wines and other liquors ferment in vessels perfectly closed, and secured from the contact of the air and light.

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This operation, considered as a chemical action and re-action of various principles on each other, may take place by the mere tendency of all bodies to form combinations. Wine which has been already fermented may undergo a second fermentation if put into a bottle wrapped in black paper, if mucilaginous sugar be mixed with it, and it be exposed to a temperature of twelve degrees above zero. The most certain proof that this chemical operation has taken place is, that on opening the vessel after some time, you observe a considerable quantity of carbonic acid gas disengaging itself, a product arising only from the destruction of the mucilagino-saccharine matter. The contact of the air then often promotes this disengagement without contributing to form the combination. Were this gas, which is extremely elastic, not retained by the force of the vessel by which it is contained and compressed, it would speedily escape. If the efforts it is continually making to disengage itself be superior to the resistance of the vessel, the latter is broken with a loud noise; therefore this gas was produced anterior to the moment when the liquid came in contact with the air. Thus it seems more correct to say, that the contact of the air promotes the disengagement of the different gases produced by fermentation, than to assert that fermentation cannot take place without the contact of the air and light.

TO BE CONCLUDED IN OUR NEXT.

List

List of Patents for Inventions, &c.

(Continued from Page 240.)

WILLIAM KENT, of the borough of Plymouth, in the county of Devon, Merchant and Agent; for certain additions and improvements in a sort of candlestick (in common use), which will be found to prevent accidental fires in the use of candles, by which so many valuable lives are lost, and such immense property consumed; and which will not be confined to chamber use, but being made on a larger scale, will be found equally useful in shops, warehouses, oil and spirit cellars, and other places where the use of a candle is found necessary. Dated July 2, 1805.

ARTHUR WOOLF, of Wood-street, Spa Fields, in the county of Middlesex, Engineer; for certain improvements in steam-engines. Dated July 2, 1805.

JAMES BOAZ, of the city of Glasgow, in Scotland, Civil Engineer; for a new and improved method of raising water, and working machinery by means of steam. Dated July 2, 1805.

ALEXANDER WILSON, of Tichborne-street, Piccadilly, in the county of Middlesex, Gun-maker; for certain improvements applicable to shot-belts and powder-flasks, and to fire arms of all descriptions. Dated July 3, 1805.

BENJAMIN BATLEY, of Queen street, in the city of London, Sugar Refiner; for a new and improved method of refining sugars. Dated July 8, 1805.

HENRY EDWARD WITHERBY, of Islington, in the county of Middlesex, Gentleman; for an apparatus for purifying and improving water and other liquors by filtration. Dated July 19, 1805.

JOHAN

Johan Gottlieb Frederic Schmidt, of Greek-street, Soho, in the county of Middlesex, Gentleman, and Robert Dickinson, of Tavistock-street, Covent Garden, Gentleman; for methods of sustaining animal life and combustion for a great length of time, at considerable depths beneath the surface of the sea, or other bodies of water, in such a manner as to enable a person making use of such means to exist, and to move from place to place, at the bottom of the sea, or, at any required depth between the surface and the bottom, with much more facility and advantage than by any other apparatus or contrivance which has been hitherto invented for that purpose. Dated July 19, 1805.

Peter Marsland, of Heaton Norris, in the county of Lancaster, Cotton Spinner; for improvements in sizing cotton-yarn. Dated July 19, 1805.

Peter Marsland, of Heaton Norris, in the county of Lancaster, Cotton Spinner; for an improvement in the process of dying silk, woollen, worsted, mohair, furhair, cotton, and linen, or any one or more of them, as well in a part-manufactured as in an unmanufactured or raw state. Dated July 19, 1805.

Thomas Chapman, of Witham in Holderness, in the county of York, Thrashing-Machine-maker; for a mill for tearing, crushing, and preparing oak-bark to be used by tanners in the process of tanning of hides. Dated July 29, 1805.

Henry Maudslay, of Margaret-street, Cavendish-square, in the county of Middlesex, Mechanist; for a process, upon an improved construction, for printing of calicos, and various other articles. Dated July 29, 1805.

ERRATUM.

In our last number, page 238, in the improved method of making varnish, for *cobalt* read *copal*. The error is in the original, and through an oversight was neglected to be corrected in our translation.

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

No. XLI. SECOND SERIES. Oct. 1805.

Specification of the Patent granted to Mr. WILLIAM WILKINSON, *of Needham Market, in the County of Suffolk; for improved Pan-Tiles for covering Houses and other Buildings.* Dated August 9, 1805.

With a Plate.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said William Wilkinson do hereby declare, that my said invention is fully described and ascertained as follows, reference being made to the drawings in the margin of these presents.

Fig. 1 (Plate XVI.) represents the lower, and Fig. 2 the upper tiles, with sections of the ends of each tile; I denominate them upper and lower tiles, from their relative situation with regard to each other when formed into a covering. The lower tile is formed so that the greater or receiving end may admit the less or dripping end of the next tile above it into its cavity, after the manner of troughs leading into each other. A perforation is made at the greater end of this tile, through which a clout nail

or other fastening may be passed into the lath that supports it.

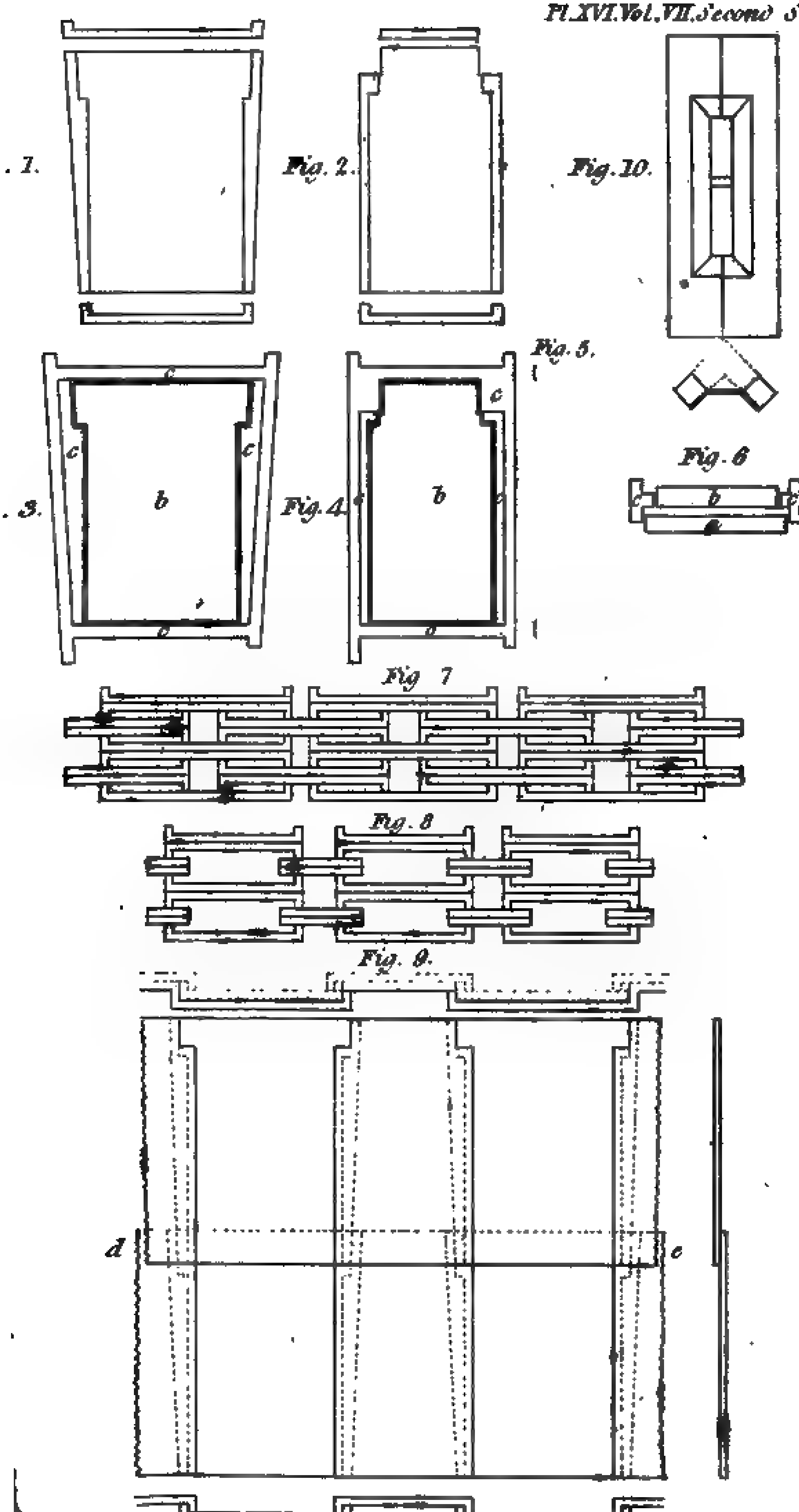
Fig. 2 is laid with its plain side uppermost. It is evident from inspection, that if two lower tiles be placed by the side of each other at a proper distance, an upper tile will receive into its cavity their raised edges, be supported by the shoulders formed therein, and closely cover the space between them.

Figs. 3 and 4 shew a form of moulds which I use for each tile; and in their aggregate consist of three parts, as exhibited by the sections, Figs. 5 and 6, *viz.* the stock mould-board and frame.

Fig. 5, *a*, is the stock, made of two boards, whose grain is placed contrary one to the other, and fastened together by screws, to prevent warping. At each end is fixed a bar of iron, with its upper side reduced to an edge, and standing above the plain of the stocks; and upon these edges rest the ends of the mould-board and the interior corners of the frame. *b* the mould-board, made of dry mahogany, and formed of two boards, as recommended for the stock. *c* the frame. I have found it necessary to make the sides of the frame somewhat hollowing on the inside with regard to their length, consequently the side edges of the mould-board will be rounded, as shewn in Figs. 3 and 4. The same letters in Figs. 3, 4, 5, and 6, refer to the same parts in each.

I have adopted the following process for manufacturing the tiles, though it is probable that trifling variations may in practice be necessary, or other methods be found more convenient, or preferred, according to circumstances; but I think it needless to describe any other, because I consider my invention to consist of the tiles when produced, and not in the method of manufacturing them. The stock being made fast on a table by a staple and wedge,

or



. 1.
Fig. 2.
Fig. 10.
Fig. 5.
Fig. 6
. 3.
Fig. 4.
b
c
a
Fig 7
Fig. 8
Fig. 9.
d
e

or otherwise, the mould-board and frame are placed thereon; the mould is then filled with earth, and struck off in the usual manner; a small quantity of sand is thrown on the face of the tile. The tile-frame and mould-board are then taken off the stock, and, with the face of the tile downward, placed on a hand-board; the tile and mould board are forced out of the frame, the mould-board taken off, and the tile laid on a floor, or placed on a stage, formed of boards, similar to those used for the common pan-tile. When the tiles are sufficiently dried they are dressed on a horse or stool, resembling the mould-board, proper allowance being made for the shrinking of the tiles. A slay or beater is made use of for dressing, flat on one side, but a little hollow with regard to the length on the other side; the flat side is used for the face of the tile, the hollow side is to beat up the edges. When dressed, the tiles are paired face to face, and chequered, as exhibited in Fig. 7, which shews the lower tile chequer, and Fig. 8 the upper tile chequer. In this state I let them remain until perfectly dry, and fit for the kiln.

Fig. 9, with its sections, exhibit the method in which the tiles are arranged when formed into a covering; the dotted lines in the body of the figure shew the covered joinings; the dotted part of the upper section shew the manner in which the lower ends of one course of tiles lap over and cover the upper ends of another course; the whole is the section of this figure, in the direction of the line *d e*. To give the covering formed of these tiles a light appearance, I reduce or chamfre off the edges, which is performed in the lower tile in the mould, by making an addition to the mould-board, as shewn by the dotted angle in Fig. 5. In the upper tile it is accomplished by a stock-shave, which I have invented for that purpose, and

which is shewn at Fig. 10. The iron of this tool has two edges, and will consequently cut with either a driving or drawing motion; this is done at the time the tile is dressed, and is in a soft state.

Fig. 10 consists of a small cutting knife, fixed in a wooden frame, of a convenient size to hold in the hand, its under side is a right angle; the knife is fixed across the angle. When the tool is drawn along the edge of the tile, it chamfres it off, and produces the effect above stated.

I have given no specific dimensions for the tiles; strictly speaking, I confine myself to none; and it is obvious that by altering the dimensions a different effect will be obtained. In the example given in the drawings, the tiles shew equal faces; but the breadth of the lower tile may be so far contracted as to draw the edges of the upper tiles close; on the contrary, the upper tile may be contracted to its least possible breadth, and by these means produce effects widely different. The figures are projected by a scale of two inches to a foot, number ten excepted.

In witness whereof, &c.

Specification of the Patent granted to RALPH WEDGWOOD, *of the Hill in Burslem, in the County of Stafford, Potter; for a new discovered and invented Composition for making Glass, upon new Principles, whereby great Advantages will arise to the Public in every Instance where such Composition is applicable.*

Dated October 3, 1797.

TO all to whom these presents shall come, &c. Now KNOW YE, that I the said Ralph Wedgwood do hereby describe my said invention, and declare that the same

same is of the description, and to be performed in manner following; that is to say: My new-invented composition for making glass is made of the following articles; that is to say, alkaline salt-pieces, or parts of China, or earthenware pitchers, or pieces of baked clay, old plaster moulds, or calcareous earths, borax, silicious earths, and terra ponderosa; and I use these articles in the following manner; that is to say, I use the alkaline salts and borax either in a state of powder or of solution, but I prefer to use these articles in solution. When I use the alkaline salts in solution, I cause to be made a solution of alkaline salts in water; and into this solution I cast pieces or parts of China or earthenware pitchers, or pieces of baked clay, the same being first heated red hot; to these I add old plaster moulds, or calcareous earth, first slacking them in a solution of borax in water, when I use borax in solution, and I also add silicious earths and terra ponderosa; all which articles I cause to be ground together, and then dried over a slow fire. When I apply the alkaline salts and borax in a state of powder, I use them in the same manner as they are now used in making of glass. When these several articles are ground together, and dried over a slow fire, I put the whole into a melting pot, and cause it to be fused with an intense heat; and when in perfect fusion I pour it from the melting pot into cold water. The quantities of the several articles will depend on the quantity of glass intended to be made, and the proportion of each article must necessarily depend in some degree on the quality of the respective articles, and also on the hardness or softness of the glass required. But by attending to all or any of the following proportions of the several articles so to be used, my composition will be made.

To

the receiver from another vessel containing the size, called the size-vessel, by means of a pipe; one end of which pipe must be immersed in the size, and the other end of which pipe must enter the receiver. In this pipe is inserted a cock, which prevents the size from entering the receiver before the air is extracted; and when the air is extracted, the size is admitted by turning this cock. Any other apparatus which answers the purpose of the pipe and cock may be used instead of the pipe and cock. When the size is admitted into the receiver it enters into the yarn, and impregnates it very rapidly. In order that the yarn may receive no injury from the rapid manner in which the size enters into the receiver, either the size should be introduced very slowly, or the yarn should be packed in baskets, cans, bags, or vessels, or otherwise, to prevent the yarn from being tossed about in the receiver by the motion of the size. When the size enters the receiver it causes the small quantity of air which was not extracted to rise to the top of the receiver. To prevent the yarn from rising above the size in the receiver, the baskets, cans, bags, or vessels, containing the yarn within the receiver, must be fastened down, so that the same cannot rise higher than the size in the receiver; or a board, lid, or other solid body, must be fixed within the receiver, at the distance of a few inches from the top of the receiver. If it be desired to give a greater pressure to the size after it is admitted into the receiver than that of the common atmosphere, the communication between the receiver and the size-vessel must be closed by turning the aforesaid cock, and then one end of a forcing-pump may be inserted into the top of the receiver; and by means thereof a quantity of condensed air may be forced upon the surface of the size. After the yarn has remained a

few

Specification of the Patent granted to PETER MARSLAND, *of Heaton Norris, in the County of Lancaster, Cotton-spinner; for certain Improvements in sizing Cotton-yarn.* Dated July 19, 1805.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said recited proviso, I the said Peter Marsland do hereby declare, that the nature of my said invention, and the manner in which the same is to be performed, is as follows.

The Nature of the Invention.

My invention consists in the extraction of the air from a vessel containing the cotton-yarn which is to be sized, or the principal part of such air, and consequently from the cotton-yarn itself, and applying the size to the cotton-yarn while the air is so extracted. The more completely the air is extracted the more perfect the operation will be.

The Manner in which the same is to be performed.

The cotton-yarn which is to be sized must be put into a vessel called a receiver, and which must be made perfectly air-tight, by fastening down the lid, or other cover, to the aperture through which the yarn is put into such receiver. Then, by means of a common air-pump connected with the receiver, or by any other means by which a vacuum may be produced in the receiver, the air must be extracted from the receiver, and from the yarn contained in it, or as much of such air as can be easily extracted. The size must then be introduced into

Specification of the Patent granted to THOMAS ROWNTREE, *of the Parish of Christ Church, in the County of Surrey, Engine-maker; for a new-invented Axletree and Box for Carriages on an improved Construction, which he calls his Mobile Collar, Axletree, and Box.*

Dated April 25, 1805.

With a Plate.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Thomas Rowntree do hereby declare, that my said invention is described in the above drawings and following description thereof.

In witness whereof, &c.

DESCRIPTION of the DRAWINGS.

Fig. 1 (Plate XVII.) represents my improved axletree, box, and mobile collar. A, the axletree. B, the mobile collar. C, the box screwed and fixed firm to the mobile collar. D, a small round collar at the end of the arm, not to touch the end of the box, but free from any rub or friction. E, a leather collar, to prevent the oil from escaping. F, the cap, screwed to the end of the box to receive and keep the oil as in other axletrees and boxes now in use. G, a nut, screwed on the arm, before the cone, to keep the mobile collar in its situation and secure on the arm. To the axletree I have no nut at the end of the arm, consequently the friction of that is done away, nor can a wheel accidentally come off by this method.

The advantages to be derived in this improved manner of constructing axletrees and boxes with a mobile collar is safety in travelling, and much less draught to the horses.

On

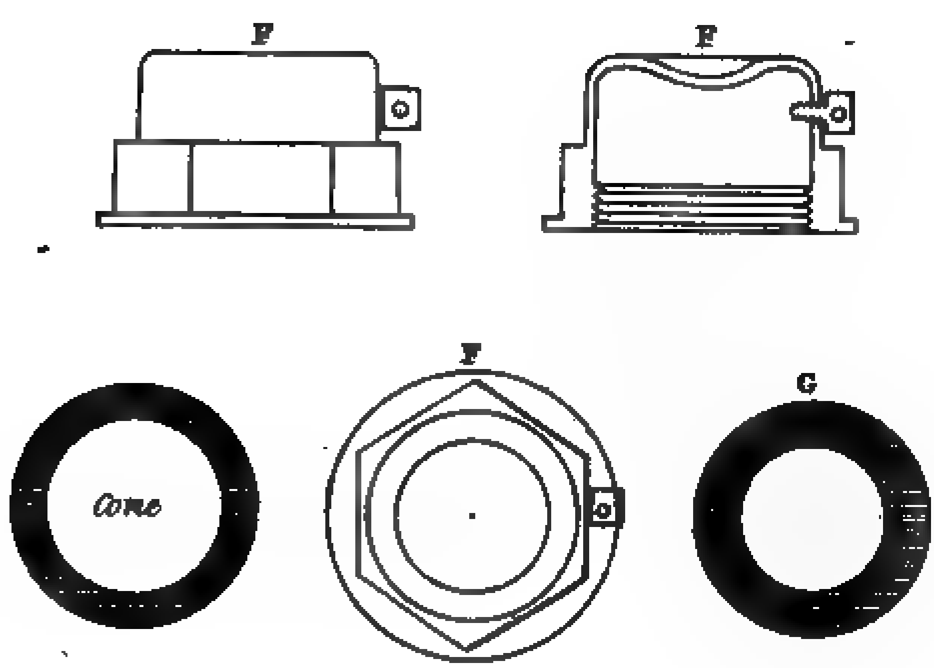


Fig. 1.

On the Use of Green Vitriol, or Sulphate of Iron, as a Manure; and on the Efficacy of Paring and Burning depending partly on Oxyd of Iron. By George Pearson, *M.D. Honorary Member of the Board of Agriculture, F.R.S. &c. &c.*

From the Communications to the Board of Agriculture.

I TAKE leave to lay before this Honourable Board, an account of a substance as a manure, which I find, on examination, is one of the things hitherto universally believed to be a poison to vegetables. Having ascertained that this substance is what is commonly known by the name of vitriol of iron, (the sulphate of iron of the chemists,) inveterate opinion prevented me for some time from accepting the testimony of it as a manure; but feeling the weight of the respectable evidence by whom it was attested, after consideration, I perceived that the fact in question was not at variance with established principles of vegetable philosophy, as I shall, I think, make appear in this communication.

My friend John Williams Willaume, Esq. of Tingrith, in Bedfordshire, having desired his brother, Charles Dymoke Willaume, Esq. to ask my opinion of a saline substance collected from peat, which has been used with profitable consequence as a manure in his neighbourhood; I proposed a set of queries to Mr. John W. Willaume, the answers to which, in the two following copied letters, comprehend the evidence I have to offer.

LETTER, No. I.

To Dr. Pearson, from C. D. Willaume, Esq.

My dear Sir,

I received the inclosed last Saturday, and hope the answers to your queries will be satisfactory, and tend to

elucidate this curious subject. Though the answers under the article *dust* only relate to your queries, yet my brother has thought proper to advert to the *ashes*, which you conceive to be a *caput mortuum;* but which have been used as, and have been supposed to be, a beneficial manure from time immemorial. I have reserved a piece of the peat from which the ashes are produced, and if you would wish to analyse it I will send it you. Favour me with the result of your future inquiries on this subject, and I am,

My dear Sir, yours very sincerely,

Walham Green, Aug. 24, 1801. C. D. WILLAUME.

LETTER, No. II.

From John W. Willaume, Esq. to C. D. Willaume, Esq.

Queries proposed by Dr. Pearson.

1. How long has the salt of peat been used?
2. How much *per* acre is laid on?
3. On what kind of lands?
4. The effects of it on vegetation?
5. Whether it is mixed with dung manure, or lime?
6. In what parts of the country has it been employed?
7. Any other facts which can be collected relative to the use of this substance?

In answering the above queries, I shall divide the subject into three articles; 1st. the *peat* considered as an object of fuel; 2d. the *ashes*; 3d. the *salt of peat, or dust;* the two last as objects of manure.

1. *Peat.*

The peat which is found after the removal of the turf or exterior surface, to about a spade's depth, has long been known as an article of fuel. It is, however, used only

only by cottagers, who burn it on a brick hearth; it has been rejected from the parlour, the kitchen, the brew-house, &c. as being injurious to grates, and to all sorts of vessels put on it; it cannot be employed in the roasting of meat, as it will impart a disagreeable taste, and it is destructive of all sorts of furniture by the effluvia which it emits, or by the dust or ashes which may chance to be blown from it. If these disagreeable consequences could be obviated, it might be made an article of general consumption as a substitute for coal, much to the advantage of the seller and consumer; it is dug out in the form of a brick to a certain depth, well known to the common labourer. This depth must be carefully attended to, lest you should cut out the staple, in which case it would never be retrieved; but, this circumstance attended to, it will grow again to its former state in the space of fifteen years. Thus the whole moor is divided into proper portions, and periodically cut once in fifteen years.

2. *Ashes.*

The turf or surface, and such parts of the peat as do not appear to be of the best quality, are laid up in considerable heaps, and reduced to ashes by the action of fire. *The ashes are red.*

Answer to Queries.

1. The ashes have been long known as a manure, and the demand is on the increase.

2. The quantity usually laid on an acre, by spreading or sowing it, is fifty bushels, either on grass or arable land.

3. It is laid on hot land. By hot land we understand sandy, gravelly, chalky soils of a dry nature, such as are burnt up on the long continuance of hot weather. It is

is most commonly used for grasses; but is in considerable esteem, as a manure, for oats or barley on land of the nature above mentioned.

4. The vegetable effect is surprising, inasmuch as it will double or treble a crop of any new-sown grass, such as trefoil, &c. I have seen the benefits arising from it on old pasture land much overgrown with moss, which it effectually destroys, and produces in its stead white or Dutch clover. You may trace to an inch the cessation and recommencement of this manure. It is observable, that near the fire heaps, as far as the wind can carry the lighter parts of the ashes, the production of clover is sure to be abundant; it is equally favourable to the growth of barley or oats.

5. It is not mixed with lime, or any other manure.

6. These ashes are bought by a set of higlers, who carry them in bags loaded on asses to a considerable distance, where they are known to be in great repute; they must come exclusively dear to the consumer by this mode of conveyance. The farmers in the vicinity send for them in waggons, particularly Mr. Brumiger, near Sundon, in Bedfordshire, a considerable and intelligent farmer, who increases his consumption every year, both for his grass and arable land.

3. *The Salt of Peat, or Dust.*

Answer to Queries.

1. The dust or gray saline substance is produced by beating the earth containing this salt to a powder; it is found in particular spots, not universally, the earth not being equally impregnated with it in all places; it has not been known as a manure above six years; but on trial greatly increases in reputation and demand.

2. Fifty

2. Fifty bushels are the proper quantity *per* acre. This should not be exceeded, for if it be laid on in too great abundance it may prove extremely deleterious.

3. It is used for cold lands. By cold lands we understand clayey, or any wet grounds.

4. It will much improve the vegetation of sowed grasses and old pasture, and is equally favourable to the production of corn; the ground, whether grass or arable, being of a cold nature.

5. It is not mixed with lime, or any other substance.

6 The dust is likewise bought by the higlers, and carried to great distances. The nearer farmers likewise send for the dust in waggons, particularly Mr. Anstie, of Dunstable Houghton, and Mr. Smith, of Sundon, who hold this manure in great esteem.

Yours, &c.

Tingrith, Aug. 19, 1801. J. W. WILLAUME.

Dr. Pearson's Experiments, Observations, and Remarks, on the Substance called Salt of Peat, or Dust.

1. It is a blackish gray, coarse, and rather heavy powder. Has no smell; tastes strongly styptic; readily dissolves in the mouth; did not deliquesce on exposure to the air.

2. Dissolves in four times its weight of water, of the temperature of sixty degrees of Fahrenheit, and in twice its weight of boiling hot water, giving a pale green-coloured solution, with a trifling sediment, which is insoluble in muriatic acid.

3. To the solution (2) I added a little liquid prussiate of vegetable alkali in a perfectly neutral state, which occasioned immediately a most abundant precipitation of prussiate of iron; and this test was added gradually, till no farther precipitation took place.

4. Into

4. Into the decanted and filtrated fluid (3) was poured liquid caustic volatile alkali, but without inducing any change.

5. Into the same fluid (3) was poured liquid carbonate of vegetable alkali, which produced a scarcely perceivable cloudy appearance.

6. Into the solution (3) was dropped the aqueous solution of muriate of barytes, which occasioned immediately a milky appearance.

7. To the solution (3) I added the oxalic acid, and turbidness ensued.

8. A little of the powdery substance, called the salt of peat, with concentrated sulphuric acid, produced no emission of fumes nor smell.

9. The solution (2) with muriate of barytes, immediately grew thick and white as cream.

10. The solution (2) with carbonate of potash, deposited a very copious greenish sediment; and the same effect ensued with caustic volatile alkali.

11. The solution (2) with oxalic acid, gave instantly a very turbid bluish green precipitation.

The preceding experiments manifested that the *peat salt* consists of *sulphate of iron*, vulgarly called green vitriol of iron, mixed with a very minute proportion of silicious earth, and of lime united either to sulphuric acid or to carbonic acid. But the presence of the earths magnesia and argill; the uncombined alkalies; the uncombined acids, are by these experiments excluded. In short, the salt of peat is almost pure *sulphate of iron.*

Remarks.

1. The salt of peat is, I apprehend, deposited by evaporations which run over the moors, where it is found; and hence I should expect many of such waters to be

strongly

strongly impregnated with it, and in many parts the soil to be tinged red and yellow by ochre. Very likely *, on inquiry, much iron pyrites will be found on or near the moors.

2. The quantity spread on land is said to be fifty bushels *per* acre, which I estimate at 2,250 pounds avoirdupoise; this will give near seven ounces and a half *per* square yard. If a larger quantity be applied, it is observed, it will prove extremely deleterious. This is true also of every other manure, such as lime, alkaline salts, marine salt, nay, of the dung of animals: for if they be used in certain quantities, they *poison* plants, instead of promoting their growth. This is equally true in the animal kingdom; for there is not an article taken as food, or as seasoning, which is not a poison, if taken in certain quantities. A human creature may be poisoned or alimented by beef or pudding, according to the quantity of them taken into the stomach. He may be poisoned, or have digestion greatly assisted, by salt or pepper, according to their quantity. In brief, the vulgar notion of the term *poison* is erroneous; for by it is conceived that substances so called are in their nature positively destructive of life; but the truth is, that the most virulent poisons are, in all reason and fact, only deleterious according to the quantity applied. White arsenic, swallowed in the quantity of ten grains or less, will destroy life; but in the quantity of one-sixteenth of a grain it is as harmless as a glass of wine; and farther, in that dose is a remedy for inveterate agues.

* "This is," says Mr. Willaume, "exactly the fact. The sulphate of iron, the salt of peat, during the heat of the summer is frequently found in a crystallized state, very white, and crackling under the feet; but is deliquescent in that form, and turns to its former dark colour when the air becomes moist."—*Note by Mr. J. W. Willaume.*

From these considerations I conclude, that there is no admissible contradictory evidence to the testimonies for the fertilizing effect of sulphate of iron, unless by such contravening evidence the quantity stated to be used exceeded fifty bushels *per* acre; it being an established fact, that in certain proportions this metallic salt is a poison to plants.

This discovery of Mr. Willaume will, I think, give new light, so as to explain fully the *rationale* of the improvement of land by the burnt earth and ashes from paring and burning. It is usual to account for the effects of this process, by referring to supposed alkaline or other salts; but of these there is no evidence, nay, on trial I have not detected them, or at least not in any efficient quantity; but this I know, that such earth and ashes contain *oxyd of iron*, and as I suspect of *manganese*; which from the analysis, and the effect of salt of peat, must now be admitted into the class of manures. This very communication of Mr. Willaume affords evidence of the truth of this conjecture, for the *ashes of the peat which affords the salt* "have been long known as a manure, and the demand is on the increase:" of course, these ashes contain an unusual quantity of oxyd of iron. A consequence of this reasoning is, that the burnt earth of soils will, *cæteris paribus*, fertilize in proportion to the oxyd of iron it contains. Accordingly the ashes of the peat, says Mr. Willaume, have a surprising effect; they "will double or treble a crop of any new-sown grass, such as trefoil, &c.;" they are so beneficial, that in spite of the expence they are carried in bags by higlers to great distances. It would be extending this paper beyond the proposed limits to reason at greater length, and to make a farther induction of facts; therefore I will close with asserting, that the more I contemplate the facts in Mr. Willaume's

Willaume's letter, the more evidence I perceive for the truth, that metallic salts, and metallic oxyds in general, and salts and oxyds of iron in particular, are manures, if applied in proper doses.

I do not think it is within the design of this paper to make observations on the answers to the 2d, 3d, 4th, 5th, and 6th queries, except, once for all, desiring that it may be understood, that I consider the *salt of peat*, *and the ashes of peat*, as operating in promoting vegetation analogous to seasoning, or condiments, taken with the food of animals; that is, analogous to mustard, cinnamon, ginger, &c. which are not of themselves at all or necessarily nutritious, but contribute to render other things nutritious, by exciting the action of the stomach and other organs of digestion and assimilation. I have no doubt of the truth of the proposition, that no living thing, neither plant nor animal, can grow and live in a state of visible action without constant supplies of *matter which has been alive*; in other words, *living* animals and vegetables can only live on *dead* animals and *dead* vegetables. No plant nor animal has ever been known by experience, nor in the nature of things does it seem reasonable, that they can be nourished by mere water and pure air, as some persons have asserted.

I shall make a few remarks on the other *two substances* which are the subject of Mr. Willaume's letter.

2. *The Peat.*

The peat is a dense mass of vegetable matter for a certain depth, partly in a *dead* and partly in a *living* state, with which is mixed more or less earth, and in burning it affords so much empyreumatic oil as to give a disagreeable taste to roasted provisions; hence, as we are told,

it has been rejected from the kitchen. This fuel affords a vast quantity of what the chemists call *lignic acid*; hence it is rejected also from the parlour, as very destructive to the gates. I beg to suggest, that this lignic acid might be saved in burning the peat as fuel, and be used for various purposes in manufactures; and the charred peat may be used in place of charcoal of wood. Probably too other useful products will be found on examining the matters more accurately which are afforded by distillation.

3. *Ashes.*

If the peat were mere vegetable matter, the ashes afforded by it would be as trifling as those of wood; but some parts of the moor contain so much earth and oxyd of iron, as to leave behind, on burning, a considerable quantity of incombustible matter; and such kind of peat, we are told, is not used as fuel; but, after burning, the residuary matter is an efficacious manure; much more so than is commonly afforded by paring and burning. The ashes are more red and more fertilizing than ashes of common turf, because they contain more iron.

The spontaneous springing up of white clover, in land manured with these ashes, is similar to the spontaneous growth of this plant on heath-land, which has been covered with lime to destroy all its present vegetation; and this fact shews that probably these are seeds buried in the earth for many ages, which yet remain alive, but do not grow until exposed to the stimuli of air, water, calorific, and lifeless animal, or vegetable matter.

APPENDIX.

APPENDIX.

The following facts, lately discovered by most respectable chemists, appear to be worth adding to the preceding memoir, as they serve to shew that other salts, besides sulphate of iron and certain earths, may be employed advantageously as manures, although, like iron, they have been esteemed deleterious to plants.

1. *Ashes of Pit-Coal are a good Manure for Grass.*

My much-valued friend, the Rev. William Gregor, of Grampound, on examination of the ashes of coal from Liverpool, found them to contain both sulphate of magnesia and sulphate of lime, especially the former, salt. I apprehend that these ashes also contain oxyd of iron, or perhaps sulphate of iron. These ashes, says Mr. Gregor, "*skeaded* *" over grass, apparently produced good effects *notwithstanding the sulphate of magnesia*, which I was well assured they contained. See Nicholson's Journal, vol. V. p. 225.

From this observation of Mr. Gregor, it seems he is aware of the prevailing popular opinion, that sulphate of magnesia is not favourable to vegetation; and to reconcile his fact with the unfriendly nature of magnesia to plants, as discovered by Mr. Tennant, he observes that the effects of sulphate of magnesia may be very different from those of magnesia and carbonate of magnesia. I apprehend it is the magnesia (calcined magnesia) only which this learned chemist found hurtful to vegetables, as the discovery was made on the examination of Nottingly lime, which the farmers near Doncaster employ as a manure, while they reject the lime of their own neighbourhood.

* From Σκεδάω.

bourhood. In the latter Mr. Tennant met with magnesia, and in the former none. See the account of this important discovery in the Philosophical Transactions.

2. *The Earth from Ashes called Cinis, is a durable and efficacious Manure; by Professor Mitchill, of New York, one of the Representatives in Congress. Addressed to Dr. Pearson.*

Dr. Mitchill, in a letter addressed to me on *cinis*, or earth found in the ashes of wood, has made some observations relative to the preceding memoir, which seem worthy of notice.

"Ashes of wood contain very commonly sulphate of potash, also phosphoric acid, besides other well-known salts; but after these salts are separated by lixiviation, there remains a *peculiar earth*, and a small proportion of iron. This earth differs from lime, barytes, magnesia, strontian, or any other known species of earth. I would call it *cinis;* for plentiful, common, and important as it is, science has not dignified it with a name. To judge of the excellence of this earth as a manure, after all the salts are extracted from soap-boilers' ashes, the earth sells for ten cents the bushel; and, notwithstanding this high price, it is not unusual for the farmer to pay for the article twelve months beforehand. When ploughed into sterile ground, at twelve loads *per* acre, it produces great crops of wheat, clover, and other sorts of grass and grain; and its fertilizing operation will last twenty years. Although some of the other ingredients of the ashes left after lixiviation may prove beneficial, yet the effects are chiefly from the cinis, or new-named earth.

"This earth, which is so prized in America as a manure, was esteemed of old in Asia, as an ingredient in cement: among the antient Syrians, it was one of the materials

materials forming the plaster of their walls; and as it holds an immediate place between the lime and potash, it can easily be conceived how it may act both as a cement and a manure. It is to be hoped, chemists will turn their attention to this important subject." See Tilloch's Philosophical Magazine, vol. VII. p. 273, for the whole of this interesting letter.

3. *Several metallic Salts promote Vegetation, shewn by the Experiments of Professor Barton, of Philadelphia.*

Letter from Benjamin Smith Barton, M. D. Professor of Medicine in the College of Philadelphia, to Dr. Pearson, containing Experiments with metallic Solutions to determine their Effects on Plants.

Sir, *Philadelphia, Oct.* 28, 1802.

In the "Annals of Medicine" for the year 1801, you inform us, that you have lately read a paper at the Board of Agriculture, "containing an account of the effects of a saline body collected from peat, as a most powerful manure, which turns out to be sulphate of iron; a substance (you remark) hitherto considered to be a poison to plants." This piece of intelligence gave me much satisfaction. I have for some years been engaged in an extensive series of experiments relative to the effects of various stimulating articles, such as camphire, &c. upon vegetables; and on the absorption of certain powerful mineral substances into the organic system of vegetables. In numerous instances I have subjected the stems and leaves of plants, young and old, large and small, to the influence of the sulphates of iron and copper. I have found that both of these metallic salts are very *greedily* absorbed by vegetables, insomuch, that I have detected the presence of iron in the vessels of a branch of mulberry,

berry, at the height of five or six feet above the place of immersion in a solution of the sulphate of this metal. A full account of my experiments I design to communicate to the public in two memoirs. Permit me to observe, in the mean while, that the sulphate of iron, applied to vegetables in the manner I have mentioned, "is only (to use your own words) a poison, like almost every thing else, from the over-dose." *In several of my experiments, the branches of vegetables that were placed in vessels containing solutions of the sulphate of iron and copper lived longer, and exhibited more signs of vigour, than similar branches that were placed in equal quantities of simple water.* It is true, that, in many other experiments, these metallic salts proved fatal to my plants; but this was when I employed too large a dose. In like manner I had found several years ago *, that camphire, by greatly stimulating, often kills vegetables; and yet, when properly dosed, this is a very wholesome stimulant to plants. I had also found, that large doses of nitre (which is unquestionably a powerful stimulant both with respect to animals and vegetables) produce an appearance like genuine grangrene in the leaves of vegetables: and yet it is certain, that nitre, when it is judiciously dosed, may be made to greatly assist the healthy vegetation of plants.

Excuse the liberty I have taken in troubling you with these few loose hints, and permit me to subscribe myself, Sir,

Your very humble,

and obedient servant, &c.

BENJAMIN SMITH BARTON.

To Dr. Pearson.

* See the Transactions of the American Philosophical Society, vol. IV. No. xxvii.

4. *Sulphate*

4. *Sulphate of Iron in the Peat of Russia, found by Professor Robinson.*

Something else besides vegetable matter is necessary to form peat or black moss of the moors. The smell of burning peat is different from that of vegetable matter. Peat ashes, says the Professor, always contain a very great proportion of iron; he has seen three places in Russia where there is superficial peat-moss, and in all of them *the vitriol is so abundant as to effloresce.* In particular, on a moor near St. Petersburgh, the clods shew the vitriol (sulphate of iron) every morning when the dew has evaporated. According to this learned Professor's observation, the sulphate of iron in pit-coal may be accounted for in the following manner: "peat mosses form very regular strata, lying indeed on the surface; but if any operation of nature should cover this with a deep load of other matter, it would be compressed, and rendered very solid; and, remaining for ages in that situation, might ripen into a substance very like pit-coal." See the Medical and Chirurgical Review for November 1803.

5. *Mr. Anstey's Testimony of the Use of Peat Dust and Peat Ashes.*

Sir, *Houghton Regis, Dec.* 3, 1801.

I received yours, dated the 18th of November last, in which you requested me to inform you what experiment I had made from the turf-dust taken from Tingrith Moor. I have made use of the ashes and dust near thirty years, and I frequently lay on from eighty to one hundred bushels *per* acre. Our land is dry and very thin stapled, owing to the chalk-rock lying so very near the

surface; it encourages vegetation in moist warm weather; but when hot and dry the reverse. We never any other manure with it. It costs about four pence a bushel, including all expences.

We chiefly spread it on our seed-grass, clover, &c.

I am, Sir, your humble servant,

JOS. ANSTEY.

Discovery of a Lake existing in Madder, and Account of Processes for obtaining it.

By Sir H. C. Englefield, *Bart.*

From the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce.

The Gold Medal was voted for this Communication.

After many experiments on the red pigment to be prepared from madder, I have obtained from it a colour far superior to any which I have ever seen produced from it. I have received from many of our most distinguished artists very satisfactory reports of its excellence. I mean to make my process public; and if it should be consistent with the views of the Society of Arts, &c. to publish it, and they should deem the improvement I have made worthy of a premium, I shall be much flattered by their approbation.

The want of a durable red colour, which should possess something of the depth and transparency of the lakes made from cochineal, first induced me to try whether the madder root, which is well known to furnish a dye less subject to change by exposure to air than any other vegetable colour, except indigo, might not produce something of the colour I wanted.

Several

Several of the most eminent painters of this country have, for some time, been in the habit of using madder lakes in oil pictures: but the colours they possessed under this name were either a yellowish red, nearly of the hue of brickdust, or a pale pink opake, and without clearness or depth of tint, and quite unfit to be used in water-coloured drawing, which was the principal object of my search.

My first attempts were to repeat the process given by Margraf, in the Memoirs of the Academy of Berlin: but the colour produced by this mode was of a pale red, and very opake, although the eminent author of the process states the colour he produced to be that of "*le sang enflammé*," which probably means a deep blood-colour. It may, however, be observed, that colours prepared with a basis of alumine will appear much deeper when ground in oil than they do in the lump, the oil rendering the alumine nearly transparent. This advantage is, however, lost in water-colours. On examining the residuum of the madder root, after it had been treated in Margraf's method, it appeared tinged with so rich a red, that it was obvious, that by far the greater part of the colour still remained in it, and that the most powerful and beautiful part. To extract this, several ineffectual trials were made, which it would be useless to enter into; but, on attentively examining the appearances which took place on infusing the madder in water, I began to suspect that the red colouring matter was very little, if at all, soluble in water, and that it was only mechanically mixed with the water when poured on the root, and suspended in it by the mucilage, with which the root abounds.

A very small quantity, therefore, can be obtained by any infusion or decoction, as the greater part sinks down

on the root, or remains with it on the sieve, or in the bag, through which the infusion or decoction is passed to render it clear. I therefore was induced to try whether, by some merely mechanical means, I could not separate the colouring matter from the fibrous part of the root. In this attempt my success was fully equal to my hopes; and, after several trials, I consider the process I am now about to describe, as the most perfect I have been able to discover.

Process I.

Enclose two ounces, Troy weight, of the finest Dutch madder, known in commerce by the name of crop madder, in a bag, capable of containing three or four times that quantity, and made of strong and fine calico. Put it into a large marble or porcelain mortar, and pour on it about a pint of cold soft water. The Thames water when filtered is as good as can be used; it being very nearly as pure as distilled water, at least when taken up a very little way above London. With a marble or porcelain pestle, press the bag strongly in every direction, and, as it were, rub and pound it as much as can be done without endangering the bag. The water will very soon be loaded with the colouring matter, so as to be quite opake and muddy. Pour off the water, and add another pint of fresh water to the root, agitating and triturating it in the manner before described; and repeat the operation till the water comes off the root very slightly tinged. About five pints of water, if well agitated and rubbed, will extract from the root nearly the whole of its colour; and if the residual root be taken out of the bag and dried, it will be found to weigh not more than five drachms, apothecaries weight; its colour will be a kind of light nankeen, or cinnamon, and it will have

entirely

entirely lost the peculiar odour of the root, and only retain a faint woody smell.

The water loaded with the colouring matter must be put into an earthen or well-tinned copper, or, what is still better, a silver vessel, (for the use of iron must be carefully avoided through the whole,) and heated till it just boils. It must then be poured into a large earthen or porcelain basin, and and an ounce, Troy-weight, of alum dissolved in about a pint of boiling soft water, must be poured into it, and stirred until it is thoroughly mixed. Abount an ounce and a half of a saturated solution of mild vegetable alkali should be gently poured in, stirring the whole well all the time. A considerable effervescence will take place, and an immediate precipitation of the colour. The whole should be suffered to stand till cold; and the clear yellow liquor may then be poured off from the red precipitate. A quart of boiling soft water should again be poured on it, and well stirred. When cool the colour may be separated from the liquor by filtration through paper in the usual way; and boiling water should be poured on it in the filtre, till it passes through of a light straw colour, and quite free from any alkaline taste. The colour may now be gently dried; and when quite dry, it will be found to weigh half an ounce; just a fourth part of the weight of the madder employed.

By analysis, this colour possesses rather more than 40 *per cent.* of alumine. If less than an ounce of alum be employed with two ounces of madder, the colour will be rather deeper; but if less than three quarters of an ounce be used, the whole of the colouring matter will not be combined with alumine. On the whole, I consider the proportion of an ounce of alum to two ounces of madder as the best.

Process

Process 2.

If, when the solution of alum is added to the water loaded with the colouring matter of the root, the whole be suffered to stand, without the addition of the alkali, a considerable precipitation will take place, which will be of a dark dull red. The remaining liquor, if again heated, will, by the addition of the alkali, produce a rose-coloured precipitate of a beautiful tint, but wanting in force and depth of tone.

This is the process recommended by Dr. Watt, in his Essay on Madder, in the "Annales de Chimie," tome 7; and this latter colour is what may perhaps, with propriety, be called Madder Lake. But, although the lighter red may be excellent for many purposes, yet I consider the colour produced by the union of the two colouring matters, as given in the first process, as far preferable for general use, being of a very beautiful hue when used thin, and possessing unrivalled depth and richness either in oil or water, when laid on in greater body.

If but half an ounce of alum be added to the two ounces of the root, the first precipitate will be nearly similar to that when an ounce is employed; but the second, or lake precipitate, will be less in quantity, and of a deeper and richer tint. In this case the whole of the colouring matter, as before observed, is certainly not combined with the alumine; for, on adding more alum to the remaining liquor, a precipitate is obtained of a light purplish red. In this process, when two ounces of madder and an ounce of alum are used, the first precipitate has about 20 *per cent.* of alumine, and the second, or lake precipitate, about 53 *per cent.*; but these proportions will vary a little in repetitions of the process.

Process

Process 3.

If the madder, instead of being washed and triturated with cold water, as directed in the foregoing process, be treated in exactly the same manner with boiling water; the colour obtained will be rather darker, but scarcely of so good a tint; and the residuum of the root, however carefully pressed and washed, will retain a strong purplish hue; a full proof that some valuable colour is retained in it, probably fixed in the woody fibre by the action of heat. Mr. Watt, in his excellent Treatise on Madder above mentioned, observes, that cold water extracts the colour better than hot water; and I have reason to suspect, that a portion of that colouring matter, which produces the bright red pigment, distinguished before by the name of Madder Lake, remains attached to the root, when acted on by boiling water.

Process 4.

If to two ounces of madder a pint of cold water be added, and the whole be suffered to stand for a few days (three or four days) in a wide-mouthed bottle, lightly corked, in a temperature of between 50° and 60°, and often shaken; a slight fermentation will take place, the infusion will acquire a vinous smell, and the mucilaginous part of the root will be in a great degree destroyed, and its yellow colour much lessened. If the whole be then poured into a calico bag, and the liquor be suffered to drain away without pressure, and then the root remaining in the bag be heated with cold water, &c. exactly as directed in the first process, the red colouring matter will quit the root with much greater ease than before fermentation. It will also be equal in quantity to that afforded by the first process, but of a much lighter red. This difference of tint appears to be owing to a destruction of

a part

a part of the lake by the fermentation of the root; for if the colours from the fermented root be obtained separate, as in Process 2, the first precipitate will not sensibly differ from that obtained from the unfermented madder, but the second, or lake, will be of a very light pink. This process then is not to be recommended.

Spanish and Smyrna Madders.

Spanish madder affords a colour of rather a deeper tone than the Dutch madder, but it does not appear to be of so pure a red as the Zealand crop madder.

The Smyrna madder is a very valuable root. The colour produced from it by Process 1 is of a deeper and richer tint than any I have obtained from the Dutch madder. The quantity produced from two ounces is only three drachms twenty-four grains: but this is not to be wondered at; for as this madder is imported in the entire root in a dry state, and the crop madder of Zealand consists principally of the bark, in which probably the greatest part of the colouring substance resides, there is every reason to think that the Smyrna madder really contains a greater proportion of colour than the Zealand, in equal weights of the entire root.

The products of Process 2 prove, that the *lake* of the Smyrna madder is more abundant in quantity, and of a richer tone, than that of the Dutch root; for, from two ounces of Dutch madder the first precipitate was two drachms, and the lake was two drachms and forty-eight grains, whereas, from two ounces of the Smyrna root, the first precipitate was one drachm and twenty-four grains, and the lake was two drachms and twenty-four grains. The proportion of the lake to the other colour is, therefore, much higher in the Smyrna than in the Dutch root.

Fresh

Fresh Madder.

The colour may be prepared from the recent root; and it will be of a quality equal, if not superior, to any other. The difficulty of procuring the fresh root has prevented me from making as many experiments on it as I could have wished. I procured, however, a small quantity of the best roots packed in moss from Holland, and the following process answered perfectly well.

Eight ounces of the root having been first well washed and cleaned from dirt of all kinds, were broken into small pieces, and pounded in a bell-metal mortar, with a wooden pestle, till reduced into an uniform paste. This paste being inclosed in a calico bag, was washed and triturated, as described in the first process, with cold water. About five pints seemed to have extracted nearly the whole of the colour. To the water thus loaded with colour, and boiled as before, one ounce of alum, dissolved in a pint of boiling water, was added, and the alkali poured on the whole, till the taste of the mixture was just perceptibly alkaline. The colour thus obtained, when dry, was of a very beautiful quality.

The success of this experiment, which was twice repeated with the same result, has led me to hope, that it is not impossible that the mode of obtaining the colour from the fresh root here described, may be productive of advantages for more extensive use than I had in view when first I attempted to obtain a pigment from madder. Many tracts of land in this country are as well adapted to the growth of this valuable article as the soil of Holland can be; and the cultivation of it, which has more than once been attempted to a considerable extent, has been laid aside, principally from the expense attendant on the erection of drying-houses and mills, and the great

expense and nicety requisite for conducting the process for drying. But should the colour, prepared in the mode just described, be found to answer the purposes of the dyers and calico-printers, the process is so easy, and the apparatus required for it so little expensive, that it might be in the power of any grower of the root to extract the colour: besides which, another great advantage would be obtained; the colour thus separated from the root may be kept any length of time without danger of spoiling, and its carriage would be only one fourth of that of the root. I am, moreover, thoroughly inclined to believe, that in the present mode of using the root, a very considerable part of the colour is left in it by the dyers; and should this prove to be the case, an advantage much greater than any hitherto adverted to, may arise from the process here recommended.

Should it be attempted to obtain the colour from the fresh root, on an extensive scale, I should recommend, that the root be first reduced to as uniform a pulp as possible, by grinding or pounding. To this purpose it is probable that the cyder-mill would answer perfectly well; and its extreme simplicity is a great recommendation. For the purpose of trituration, bags of woollen, such as are used in the oil-mills, would probably answer as well as calico, and they would be much cheaper and more durable. A large vat, with stampers, would be easily constructed, by those who are conversant in mechanicks, for the holding them and pressing them in water; and when the colour was boiled and precipitated, the flues of the boilers might easily be formed into convenient drying-tables, without any additional expense of fuel. The part of the process which I consider of the greatest importance, and as being the essential advantage of my methods over all those which have come to my knowledge,

ledge, is the trituration or pressing of the root in water; and I believe that the colouring matter of the root has not been hitherto considered as so nearly insoluble in water as I have reason to think it is.

It were much to be wished, that in the present advanced state of Chemistry some skilful analyser would investigate the properties of this very useful root; in which perhaps it will be found, that there are three, if not four, different colouring substances. Such are the processes and views which I have thought it not improper to submit to the consideration of the Society of Arts, &c.

I have only now to describe the specimens which accompany this paper; assuring the Society, that they have been all prepared by my own hands entirely, and that I am therefore responsible for their having been produced by the processes stated, without the addition of any foreign matter whatever, excepting the cake ground up with gum, and the bladder of oil-colour, which were prepared from the colour which I gave him, by Mr. Newman, of Soho-square, whose skill and fidelity are too well known to need any testimony in their favour.

It may be proper to add, that all the colours produced from the Dutch madder were prepared from the same parcel of crop madder, in order that the differences in them might proceed from the processes, and not from a variation in the qualities of the root, which, in different specimens, will produce different shades of colour under the same mode of treatment.

1. Dutch madder, treated by Process 1st.
2. Ditto - - - - - - - Process 2d.
3. Ditto - - - - - - - Process 3d.
4. Ditto - - - - - - - Process 4th.

 5. Dutch

5. Dutch madder, two ounces; alum, half an ounce; treated by Process 2.
6. Dutch madder, two ounces; alum, one ounce; fermented two days, and then treated by Process 2.
7. Produce of Process 1, ground in gum by Mr. Newman.
8. Produce of Process 1, ground in oil by Mr. Newman.

S—1.	Smyrna madder,	by	Process 1,
S—2.	Ditto	- - - -	Process 2.
S—3.	Ditto	- - - -	Process 3.
S—4.	Ditto	- - - -	Process 4.

Certificates accompanied the foregoing description, from Mr. Cotman and Mr. Munn, testifying the merits of Sir H. Englefield's madder lakes, as water-colours; and also from Messrs. West, Trumbull, Opie, Turner, Daniel, and Hoppner, speaking greatly in its favour, where it has been tried in oil-colours.

Improvement of the Swivel Loom, so as to weave Satin Guard or figured Laces. Invented by Mr. JAMES BIRCH, *of Tavistock-Mews, Tavistock-street, Tottenham Court-road.*

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

A Bounty of Twenty-five Guineas was voted for this Invention; and a Model and Patterns of the Articles wove are reserved in the Society's Repository, for public Inspection.

THIS loom is worked by a circular motion of the hands, without treadles, or any application of the feet. A wooden bar, to which the hands are applied, works two cranks

cranks on a long iron axle, extending the width of the loom; one crank is near each end of the above axis, a fly wheel is attached to one of the ends of the axis, to regulate the motion of the machinery; an endless screw, placed upon the axis, works a star wheel underneath it, which turns a barrel, that has a resemblance to that of a hand-organ, and has wooden pegs fixed in different parts around it: these pegs catch upon levers, which draw forward the cords which form the figure, and pull them down by a claw, which secures the cords thus brought within its power, and by that means raise the upper geer connected with the cords.

In this loom fourteen pieces of satin guard, or bed lace, are wove at the same time, either of one pattern and breadth, or all of different patterns and breadths, as may be required. The figure may be extended to any number of shoots desired.

The loom takes up no more space than a common swivel loom, such as is employed in plain-work; it appears to work with ease and expedition, to make good work, and to be easily managed. It does not break or chafe the silk during its working. The weaver can move to any part of the front of the loom to inspect the work, and continue the motion during that time, and the figure or pattern may be formed double the length of those usually done in the engine-loom; the loom can be stopped when required, at any one shoot of the shuttle; and it will answer to weave articles made of silk, wool, cotton, or linen, or mixtures of those articles, or gold and silver lace; and performs its work in half the time of an engine loom.

A common swivel loom costs about thirty pounds; and this invention may be added to it for six pounds more.

A cer-

A certificate from Mr. Thomas Ikin, of Maiden-lane, manufacturer, states, that James Birch is the sole inventor and maker of the above swivel loom; that it makes different sorts of figured lace at one time, in silk, cotton, worsted, or thread; and that by this loom the above-mentioned work may be made at considerable reduced prices, to what it can be done in any other loom.

Certificates also from Matthew Birch, William Rylance, and Issachar Thorpe, weavers, confirm the above statement as an undeniable fact.

On a Mistake as to the Priority of Invention of the Principle of the Horse-Engine, described by Mr. Boswell *in a former Number of the present Volume. By Mr.* Gregory, *of the Royal Military Academy, Woolwich. With Mr.* Boswell's *Reply.*

Royal Military Academy, Woolwich, Aug. 19, 1805.

Gentlemen,

The Thirty-eighth Number of your Second Series has just been put into my hands, in order that I might make a comparison between Mr. J. W. Boswell's contrivance for producing reciprocating rectilinear motion, of any proposed duration, from a circular movement, with a method devised by M. Prony for the same purpose, to which that gentleman refers.

Mr. Boswell's method is certainly much the simplest of the two, and therefore far preferable; but it may not be altogether improper to inform you, that it is likewise much the *oldest* method; a circumstance of which Mr. Boswell, in all probability, was not aware. The method has been known and practised at least half a century, in

some

some of the Northern and Western counties; and is, indeed, described, with a drawing, in Emerson's larger Mechanics, published about fifty years ago. The description may be seen at page 216, of the fourth (quarto) edition, where also a method is mentioned of producing this alternating motion without being under the necessity of having the horizontal axle on which the lanterns B B turn, and the rope winds, moved to and fro. This is effected by merely making these lanterns or pinions so as to play freely upon their common axle, except they are stopped by a pin, which *fixes* them: the application of such pin to first the one and then the other of the lanterns, produces the alternating motion as required.

In one respect, however, the English method is not "equally effectual" with that of the celebrated French engineer, since it does not preclude the necessity of a manual operation to reverse the movement: and it may be an useful exercise of the mechanical ingenuity Mr. Boswell is known to possess, if he will endeavour to furnish an appendage to his contrivance, of equal simplicity with the rest, that may accomplish this desirable object.

I am,

Gentlemen,

Yours very respectfully,

OLINTHUS GREGORY.

P. S. Permit me to mention here, that my "General Treatise of Mechanics," two volumes, octavo, one devoted entirely to the theory, and the other to the practical and descriptive part, is now pretty far advanced at the press, and will be published in a few weeks.

Reply to the preceding Letter, by Mr. Boswell.

Gentlemen, *Aug.* 22, 1805.

I return my thanks for your favour of forwarding to me, before publication, Mr. Gregory's remarks on my paper, relative to a horse-engine for raising ore and coal without reversing the motion of the horse; and also thank Mr. Gregory for the civil manner in which he has pointed out my mistake in imagining that the principle which I used in that engine had first occurred to me.

Mr. Gregory is perfectly right in supposing that I was unacquainted with the passage in the book which he mentioned: I had never seen the book but casually before yesterday, when I examined it in consequence of the above letter; for considering it, though a work of considerable merit, very inferior to Dr. Desaguilier's Lectures, and some others on similar matters, I had always been in the habit of consulting the latter in preference.

I acknowledge that the principle on which the engine chiefly works is there stated: but the particular application of it, which I have made use of, is not stated, nor the method of shifting the whole axletree which I have used. For though the axletree is directed to be shifted, the means of doing it are not mentioned; so that, even if I had seen the book before, I might still state that the application of the principle to that particular purpose, and the arranging and ordering all the frame-work, and other necessary parts of the machine, so as to fit it for actual use as an horse-engine for raising coals or ore, was my invention.

As to the mistake of supposing a certain principle of mechanism had not before occurred to another, I am not singular in this respect. M. Prony has fallen into the

same

same error; for in the same page of the book which Mr. Gregory mentions, the principle which he has used in constructing an engine for a similar purpose is also mentioned; in which he has made the axle stationary, and the pinions or small wheels moveable on it.

I have also to urge in excuse for this mistake, that the circumstance of the Society for the Encouragement of Arts having offered a premium for the discovery of a horse-engine for raising coal and ore, without reversing the motion of the horse, banished from my mind the least suspicion of even any principle being known on which the thing might be done, as it was but fair to conclude, that, if it had, it would have been known to some of the many well-informed gentlemen who compose that Society.

Mr. Gregory also mentions, that the method had been practised in the Northern and Western counties. To this I also plead ignorance: and am inclined to think he has been misinformed, at least as far as relates to the Western counties, (for as to the Northern I can say nothing from experience, never having been there). I made my model in the town of Barnstaple, which is very far West, and there shewed it to several gentlemen who were well acquainted both with mechanical subjects and with the state of the Western counties, and never before had the smallest intimation that any thing of the kind had been done there. If Mr. Gregory does not speak from his own observation, he may easily have been misled by report; for nothing is more frequent than for mechanical combinations to seem similar to casual or superficial observers, which are in their nature and properties essentially different.

I must beg leave to differ in opinion from Mr. Gregory, that M. Prony's method of making the engine reverse its own motion without manual assistance, is of ad-

 vantage

vantage in engines for raising coal or ore; for as men must always attend with carriages to remove what is brought up by the engines; and there must be some little variation of time or position in each carriage getting into the proper place for receiving its loading, there will be a considerable convenience in being able to detain the buckets at pleasure, so as to suit these circumstances. Add to this, that where a person must be employed to drive the horse, the manual operation of shifting a lever (which will of course be performed by the driver) will add nothing to the expense of the work, and next to nothing to the labour.

If Mr. Gregory would have the goodness to mention a few of the places where horse whims are to be seen, constructed with the same advantages as those which are the subject of discussion, he would oblige many others as well as me, who are all equally ignorant of their existence.

I am, &c.

J. W. BOSWELL.

Account of the double Boats built by the Direction of Sir Sydney Smith; *the Nature and Properties of this Species of Vessels, Method of building larger of the Kind, with sufficient Strength, and of those of similar Construction formerly built.*

Communicated by Mr. J. W. BOSWELL.

THE boats built by direction of Sir Sydney Smith have excited some curiosity; their construction is so different from what is usual in this part of the world, that a multitude of strange conjectures are every day formed of their use and design. It is therefore imagined, that the following

following account of these boats, and their properties, and of other vessels of a similar nature, will not be unacceptable to the readers of the Repertory.

The first double boat built for Sir Sydney Smith, consists of two of the common Thames-wherries, united by a stage or platform laid over them, of about twenty feet breadth. The wherries were raised one streak to receive this stage, which is formed of pieces of scantling, about six inches by three in thickness, laid across the boats, and firmly secured to them, upon which a deck is afterwards laid down. Beyond this stage the boats project about five feet at either end; which parts are also decked over, and the whole made water-tight above. Long narrow hatchways open into each wherry. Their heads and sterns are connected by cross pieces, and each is furnished with two masts, so that the double boat carries four masts in all; on which sprit-sails are used, for the greater convenience of reversing the direction of the vessel without putting about, either end being formed so as to go foremost at pleasure with equal facility.

Two other vessels have been since built on this plan, on a larger scale, called the Gemini and the Cancer. The stages or platforms of these boats are not so broad in proportion as that of the first. The Gemini has also her two supporting boats formed with the internal side of each perpendicular, and straight, so that each resembles half of a boat, divided lengthways, vertically. The shear of the latter boats is also much greater than that of the first, their extremities being considerably higher than their decks. The Gemini has four masts, the Cancer it is said has not more than two. They are each furnished with a small gun, placed on the middle of the platform, and are fitted with a suitable number of oars, to be used in calm weather.

Sir Sydney's particular destination for these boats is not made public, nor would it be proper to investigate this subject; but the nature and properties of vessels of this kind depending on their construction, require no communication of secret intelligence to point them out, and are as follows.

The chief advantages of double-hulled vessels are, first, the great velocity with which they may be made to sail. This arises from two circumstances: first, their great extension of breadth gives them such a bearing as removes all danger of oversetting from press of sail; and, secondly, this same circumstance renders it unnecessary to carry any ballast, by which the vessel will be so much lighter, draw the less water, and of course make less resistance.

The second excellent property which these vessels possess relates also to their sailing. Their construction is such as best fits them to resist making leeway; for the double-hull makes double resistance to lateral motion, which is farther increased in such of those vessels as are built like the Gemini, by the flatness of the internal opposite sides, one of which must always be to the leeward in every tack. This good quality will also enable them to lie closer to the wind than other vessels, by which they can work to windward better if pursued, and from this circumstance alone escape, when thought fit, in most cases; while their resistance to leeway enables them to lie close to shore, where other vessels dare not approach without the most imminent danger.

The third advantage of these vessels is quickness of manœuvering. This is caused by two circumstances; the first of which is, that, being formed to go with either end foremost, they can change their tack without going about, by which much time may be saved either in escape or pursuit. The other circumstance depends on the superior

perior power which the helm possesses in these vessels, by which they can be put about with so much more quickness as to run little risk of ever missing stays. This advantage arises from the centre of motion in these vessels lying in the middle, between the two keels, by which the action of turning round is performed by one vessel going forward with more velocity than the other, without occasioning so much lateral resistance, whereas in common vessels, the centre of motion being in the vertical plane of the keel, the lateral resistance in going about will be the greatest possible.

The fourth principal advantage of these vessels is, that, from their great steadiness, if used in war, they can direct their guns with more effect than other vessels of equal burden.

Fifthly, these vessels would take the ground well, and lie steady and secure, where other vessels would be overset, which renders them very convenient for conveying men or stores to or from shore to larger vessels.

Sixthly, the great proportional size of their decks gives more room for working guns and managing the sails, and enables them to carry more guns in their bows or sterns, to use when chasing or pursued, than other vessels.

It evidently follows, that, from all these good qualities, no vessels can be better calculated for advice-boats, to watch the fleets or coasts of the enemy, and bring back the most speedy intelligence. If a few of these vessels had attended Lord Nelson in his pursuit of the French fleet, there can be little doubt that the superior advice he would, by their means, have obtained of the course of the enemy, would have enabled him to come up with them. And as the French have now become adepts in the art of escaping, the adoption of vessels which

the first boat made on this plan, which had no shear at all, and was much too short in proportion to its breadth.

The sails most proper for this kind of vessel, are those of a lifting nature; or which, by having some inclination to the horizon when filled by the wind, tend to raise the vessel: of those in common use, there seems none better calculated for this purpose than the triangular latine sails used in the Feluccas of the Mediteranean, which are also of the same nature as those of the flying proas: and if one of these sails were formed so that the two sides opposite the yard were of equal length, by merely hauling down the elevated end of the yard, and thereby raising the other end, the vessel at once might be put on the different tack, so as to go with that end foremost which before was aft. The use of the equality of sides of the sail mentioned, is that either side may serve indifferently in the place of the other without altering the position of the yard on the mast. Another species of lifting-sail, much more powerful than this for the purpose, is, however, known to the author of this communication, which there is not room to describe here.

There does not seem to be any peculiar advantage either in the number or position of the masts in Sir Sydney's boats; the chief use of numerous masts, and the consequent number of sails, is that each sail may not exceed a manageable size, but this in small vessels can have no importance. It appears then, that two masts, placed as usual in the fore and aft central line of these vessels, would be fully sufficient for them.

Though for vessels of this kind, formed on boats, and in such seas as the best constructed boats are supposed fit to encounter, the framing of the platform may be sufficiently strong with a single series of beams to connect the

the two hulls together. Yet, for sustaining such dreadful tempests as are recorded to have been experienced by the Woodcot Indiaman in 1795, and most old seamen have witnessed, neither the size of the vessels, nor the mode of connecting them, would afford adequate strength; for a single row of beams cannot be made to resist the twisting motion they would experience when the heads or sterns of the bearing-boats were violently impelled in different directions, vertically, by the impetuous motion of the waves.

The author of this communication, esteeming it a matter of consequence to the country, that vessels of such admirable properties should be made fit for any service or any seas, takes this opportunity of stating, that double-hulled vessels may be made of a proper size to perform the longest voyages, and of any required strength, by adopting, in particular parts, the same principles of framing on which the ship Economy was built under his direction (a description of which may be seen in No. II. Second Series, of this work); and that he has no doubt he could convince any gentleman of the truth of this assertion, who should desire to have a vessel built in this manner. Vessels of this kind, of a large size, should of course not depend on a single series of beams to unite them, but should have two series of beams at least, one over the other, with a space between each series not less than five feet; the lower series of beams should be planked outside, the same as the rest of the vessel, which thus forming the bottom of a third vessel in the midst of the other two, should slope gradually upwards at either end, that it might both make less resistance to the waves, and tend to rise over them when it encountered them. This middle vessel, instead of being entirely sustained by the other two, might be constructed so as to draw a foot or two of water,

 which

which would both ease the strain on the others greatly, keep up the head of the vessel against the depressing impulse of the sails, prevent the sudden and violent percussions which a flat surface, suspended at a small distance above the waves, must suffer from them in rough weather, and afford stowage for cables and a number of articles, without the bad effect of loading on a part entirely unsupported by the water, which it otherwise must experience.

This middle vessel, besides the superior convenience which it would afford for stowage and lodging for the crew, would also give great security in case of a dangerous leak taking place in either of the side vessels; for by it the whole could be so sustained, occasionally, that it might be brought safe into port, though one of the side-vessels was entirely water-logged.

Double vessels, of a large size, should not be made to go with either end foremost; for, besides the impossibility of staying the masts properly for this purpose in them, they could not thus be shaped to the greatest advantage for sailing swift; for the head requiring a certain fullness to bear up against the impulse of the sails, and the stern a certain run, or length of slope, the head also requiring the sloping or rounding off to be sidewise, and the stern requiring the run, or sloping, to be mostly from the bottom upwards, the shape which would be fit for one would not be fit for the other, and an intermediate shape would not be perfect either way.

Small double vessels may have the platform greatly strengthened by two or more pair of shears erected across it, each well secured to the deck by a perpendicular shroud descending to it from the upper angle, or by a mast rising in that part, well bolted to the platform below, and firmly fastened to the shears above: it is imagined

gined the shears in the first of Sir Sydney's boats might have been for this purpose.

In concluding, it is proper to notice another species of vessels, projected by Mr. Gordon before mentioned, which he averred would have all the good properties of the double vessels, be much stronger, have much more stowage, and require less timber in their construction; and which certainly are worthy of a fair trial. These vessels were to be very flat, draw very little water, and have their capacity in length and breadth chiefly; and to prevent making leeway, they were to have beneath their flat bottoms a number of deep narrow keels, three or four feet from each other, and were to be furnished with two or more rudders each, if one was not found sufficient for their management.

Some Account of the Archway or Tunnel intended to be made under the River Thames.

Communicated by a Proprietor.

With a Plate.

THE great inconvenience sustained by the citizens of London, and the metropolis in general below London Bridge, but more especially by the inhabitants of Wapping, Shadwell, Deptford, and Greenwich, from the want of an uninterrupted land communication across the river Thames, induced a number of gentlemen to apply to Parliament, in the last session, for powers to make underneath the river Thames a communication, by means of a tunnel or archway, for foot-passengers, and a larger for carriages; and, having obtained an act, they propose of course to enter upon the smallest first.

The

The site chosen for the opening of the foot-passage is a little to the West of the London Docks, on the North side, and in a line opposite thereto on the Redriffe side. The carriage-road is intended to be opened at or about the antient horse-ferry at Limehouse and Redriffe.

There is surely no principle better established and proved, by the internal history of every country, and of this great commercial nation in particular, than that the facilitating of communications between the various parts of a country has a direct and sensible tendency to augment its trade, and consequently to increase its wealth and population. Innumerable instances might be adduced from various parts of the kingdom to illustrate this general position. The increase, or rather, in many cases, the creation of the commerce of particular towns, has arisen from the establishment of canals, from the making of turnpike roads, and from the various circumstances and occurrences by which facilities of communication between different places have been produced.

But there is no instance, there can be no instance, no fact more parallel or analagous to the case before us, than that which we are enabled to draw from the history of Blackfriars Bridge.

Previously to the erection of that bridge, the inhabited part of the South side of the river adjacent was confined to one narrow street, which has since increased to a very populous suburb; an effect naturally resulting from facilitating the intercourse between the metropolis and any point in its vicinity.

Among the advantages which will naturally result from the proposed archway, are,

First, connecting the opposite shores below London Bridge; which, of all others, demand an easy and improved communication.

Secondly,

V. Second Series

Sect

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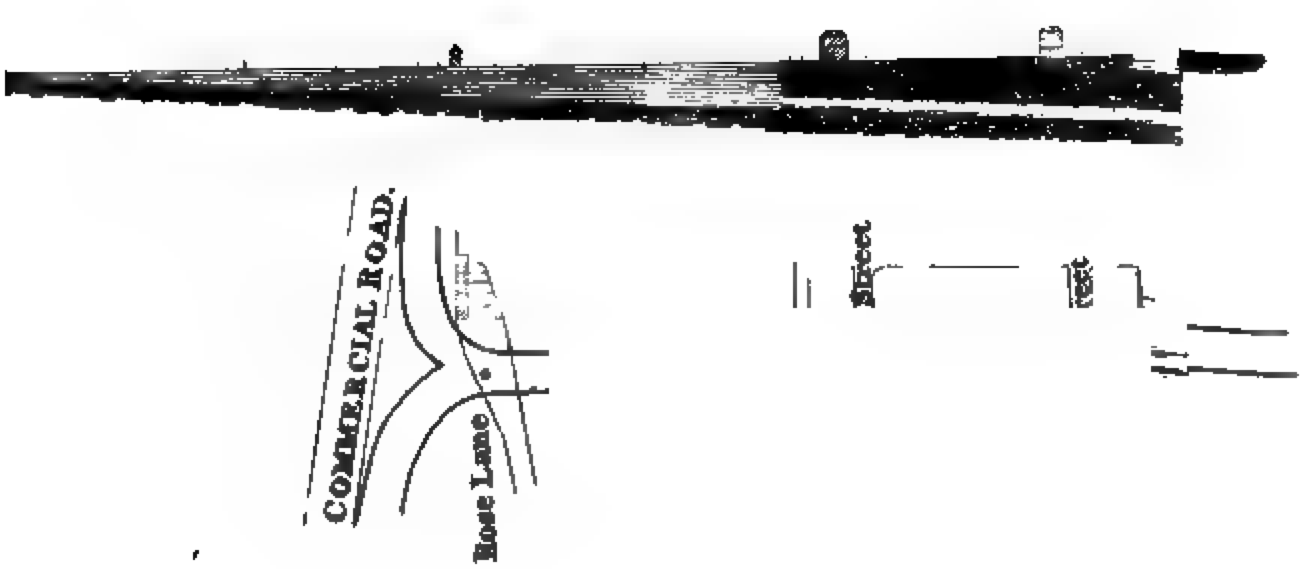

Secondly, increasing the traffic of the two shores, by uniting them into one neighbourhood.

Thirdly, forming a military pass, by means of which, in cases of emergency, facility will be given to the movement of troops.

The recent establishment of the London Docks, West India Docks, East India Docks, and the Commercial Road, on the North side of the river, and of the Rotherhithe Dock, the Grand Surrey Canal, and the Dartford Road, leading through Rotherhithe to London on the South side, require a greater facility in passing from shore to shore than can be produced by a ferry, more particularly when interrupted by that prodigious number of ships which constantly occupy the Pool.

To the foregoing noble and stupendous works the intended passage will add one no less admirable, for the conveniences which it will produce, than for the singularity, novelty, and boldness of the undertaking.

Measures are taken for immediately entering upon the execution of the plan, under the direction of engineers of the highest reputation, who entertain no doubt whatever of accomplishing it.

Plate XVIII. exhibits plans and sections of both undertakings.

It will be observed, that in the foot-path archway the entrances are shewn by circular staircases, at a small distance from the borders of the river; but this part of the plan, as well as the inclination of the line of the tunnel, will be subject to such alterations as circumstances in the progress of the work may point out.

New

New Method of forging Platina.

By Count Von Moussin Pouschkin *and* M. Geylen.

From Neues Journal der Chemie.

1. DISSOLVE the platina in nitro-muriatic acid. For this purpose pour upon it one part of metal, two and a half parts of nitric acid, and five parts of muriatic acid; a little more than half of the platina is dissolved. When we operate upon a large scale, the solution ought to be performed in a distilling apparatus, in order that the acid may be collected. Pour upon the residuum the acid which has passed over in the distillation, and repeat the same operation a second time.

2. Concentrate the solutions to the degree of crystallization, and dissolve the salt anew in water; then precipitate, in the ordinary manner, by ammoniac. Collect the precipitate upon a filtre, pass a little cold water over it, and dry it upon a plate of earthenware or porcellain.

3. When the precipitate is dried, put it into a Hessian crucible, or any other that strongly resists fusion; cover the crucible lightly, and proceed to the reduction with the strongest forging heat; then uncover the crucible, and keep up the fire still for some time; after cooling, wash the mass with a large quantity of hot water.

4. In order to separate the remainder of the iron, boil the matter for some minutes in dilute muriatic acid; separate it by the filtre, wash it well, bring it again to an intense red heat, and continue it therein for a considerable length of time.

5. Then take for one part of platina thus treated, which is now very white, three parts of mercury, and triturate them together in a mortar of silex, with a pestle of the same substance, till they are perfectly amalgamated. The

amalgam

amalgam of platina is easily made, especially if we operate at first with small quantities of matter. As soon as a small quantity of amalgam is formed, nothing more is required than to add alternately mercury and platina for the union to take place almost instantaneously. We may easily amalgamate two pounds in the space of two hours.

6. After this amalgam is well formed, and admits of being spread out very equally in all its parts, transport it into wooden moulds which are accurately closed with stoppers of the same substance, and compress the amalgam as much as possible in a press, or with the aid of weights. If no haste be required, leave the amalgam for some time in this state of compression; otherwise an hour is sufficient. The superabundant mercury runs down along the sides of the moulds, in which some very fine grooves ought previously to have been made.

7. Now remove the stoppers, and place the amalgam, together with the moulds, in a crucible, and heat the whole to incandescence in the forging furnace.

The wood is converted into charcoal, the mercury flies off, and the platina remains in the figure which it has assumed in the mould. Place it again in the crucible, and keep it for a long time at a strong red heat, moistening it from time to time with a little oil, which augments its malleability.

8. After this, have the bar carefully compressed, by a good workman, in the same manner as is done with those of silver, and after the metal has acquired the necessary solidity, beat it, in order to elongate it. This operation is performed with the greater facility in proportion as the mass is larger and the platina and mercury purer.

When we operate on a large scale, we ought to have a particular apparatus for preparing the amalgam, and the

mercury

mercury should be collected by distillation. If, during the forging, any scales of iron should attach themselves to the platina, it will be sufficient to plunge it for a few minutes into weak muriatic acid, and wash it.

The anvil and the hammer ought to be very smooth, and at first we ought to employ a convex hammer, rounded at the margin, in order that the metal may receive no impressions capable of cracking it; but when once it has acquired a certain density we may apply any kind of hammer.

Addition by M. Gehlen.

I take this opportunity to make known an observation, which not only confirms the method of Count Von Moussin Pouschkin, but also furnishes a means of greatly abridging his process. Some years ago, wishing to procure pure platina, I precipitated, by an excess of mercury, a considerable quantity of platina, dissolved in nitro-muriatic acid. I obtained a black precipitate, which, after washing and drying, presented a heavy powder, but which had little compactness, and nothing of a metallic lustre. I introduced this powder into a Hessian crucible, and exposed it to a heat, which I gradually augmented to incandescence. In proportion as the heat was augmented, and the mercury dissipated, the matter in the crucible shrunk more and more together, till at last it occupied not more than a fourth or fifth part of its former volume; it had then a fine platina lustre, and formed a coagulated mass, which however had a great many cavities. The large pieces detached from the mass admitted of being beat out by the hammer. M. Klaproth and others have seen this platina in my possession. It was this, together with some of the other procured from the triple ammoniacal salt, which M. Rose and I employed for our experiments

periments on palladium. I had not lost sight of this observation; but want of platina prevented me from following up the experiment. I think that if the black powder which I obtained were treated by the mechanical means prescribed by M. Von Moussin Pouschkin, a more compact and a more forgeable metal would be obtained. Thus the precipitation by sal ammoniac would be spared, and we should be able to obtain the mercury employed for the precipitation, by separating it from the solution, by the aid of iron.

Examination, chemical and pharmaceutical, of the Products of the Grape, not fermented.

By M. PARMENTIER.

(Concluded from Page 318.)

WE know that the grape, when arrived at maturity, decays on the plant, without undergoing spirituous fermentation. The juice of fruits is much less disposed to it after being boiled on the fire, because it loses by ebullition a portion of its ferment, which is separated in the form of scum, and likewise when it is deprived of too great a quantity of water. The juice of grapes, kept in a cold place, clarifies without fermenting, and soon exhibits on its surface some spots of mould. Lastly, honey and the syrup of sugar, exposed in a damp place, experience a movement similar to that which spoils sweetmeats that have not been sufficiently boiled; like them, they all turn sour without having undergone the spirituous fermentation.

This example we have just quoted is a new demonstration of our opinion on spirituous fermentation. The grape

as it exists on the vine should be considered as a being enjoying a distinct life, composed, like all others, of a system of organization, in which are vessels of every kind, contributing to the nourishment of the individual, the augmentation of its size, in a word, to its perfection. If, therefore, all is in its natural order, or if all the organic parts are in their proper places, and fulfil their functions, it is evident that the fermentation cannot derange them, excepting, by some accident or other, you change their disposition, confound them, or produce a mixture more or less complete. In this case, amidst such confusion, the exterior agents will exercise their influence on these different parts, will determine the intimate and reciprocal action of each, and, if the law of attraction meets with no obstacle, will change the simple substance into double, treble, &c. combinations; and, in a word, the disorganization of the bodies will be the result of it. Thus, whenever the grape decays on the plant, it is not attacked at once over the whole mass, but it is on the upper surface that the alteration commences. It extends successively to other parts, and at length deranges the whole system, while the alcoholic fermentation has not time to take place, for this very simple reason, that each part is disorganized individually, and not in a state of mixture.

It likewise happens, that the whole bunch, being exposed to the sun, or being suspended from the cieling of the fruitery, to preserve it the whole year round, instead of fermenting, undergoes no other change than the desiccation proceeding from the loss of a very great portion of its moisture. In this case it is less possible for the fermentation to take place than in the former: first, because, whenever a fermentable substance loses a portion of the humidity which contributes to produce or promotes

motes this movement, the same movement is checked or destroyed; secondly, because the loss of this humidity does not derange the interior organization of the grapes, and produces, at the farthest, only a concentration of the organic parts, without dividing or confounding them. It is equally obvious, that it is by no means by the privation of the contact of the air with the matter contained in the pellicle of the grapes, that the fermentation is retarded; for, in proportion as the internal humidity evaporates, by means of the pores of this pellicle, the external air exercises an influence more or less powerful on this fruit, as well as the light, which, as we know, passes through it, as at least the white grapes are remarkably transparent.

Admitting that the temperature of from twelve to fifteen degrees is necessary for the fermentation to take place, it cannot be denied that a less heat, or a cold temperature, must prevent it; the division and the dilatation of the principles of which must is composed not being carried to a sufficient degree, the chemical action cannot ensue, and hence the equilibrium that is observed in the liquid. As these principles separate one after the other, in the order of their gravity, and the attraction of similar parts, the mucilage is decomposed on the surface, the tartar is precipitated with the colouring matter, the juice becomes limpid, and would at length even furnish a saccharine, crystallized matter, if all the mucilage which envelopes it were destroyed by removing successively the coverings of mould that are formed on the surface of the liquor.

Syrup of Raisiné.

It is often the case that, instead of prosecuting the evaporation of must to a half solid consistence, people de-

 sist

sist at the moment when the liquid has arrived at the state of syrup, and it cannot be doubted that this preparation, on which sufficient attention has not perhaps been bestowed, might be employed in domestic œconomy.

The art of concentrating sweet wine by means of caloric was known in antient times, and was practised by the Lacedæmonians. The Spaniards, after expressing the juice of the grape, added to it a quantity of new plaster, which, possessing the property of decomposing the tartar, consequently diminished the quantity of that which existed in this liquid and its acid quality. It is in consequence of this two-fold property that it has recently been proposed to add a small quantity of chalk to the juice of grapes, for the purpose of obtaining a syrup less tart. I have subjoined some experiments, which I made with a view to save sugar, to turn local productions to advantage, and to improve them.

I took six pounds of the juice of black grapes, very ripe, and lightly expressed, that I might not have too large a quantity of extractive matter; it was turbid, having a reddish colour, and a saccharine, rather tart, and mucilaginous taste. Having clarified it with albumen, I placed it on a gentle fire, and boiled it to the consistence of syrup. This syrup being acidulated as it cooled, deposited a thick matter, of a reddish colour, resembling that of the liquor.

From a careful examination of this substance, I observed that it furnished a great quantity of acidulated tartrite of potash, combined with much mucilaginous sugar; the most limpid liquor which floated on the top contained, exclusive of a considerable portion of saccharine matter, malic and acetous acids, and undoubtedly tartaric acid in small quantity. The abundance of the mucilaginous

cilaginous saccharine matter contained in this syrup would soon have produced a movement of fermentation, notwithstanding the degree to which it had been boiled; but it is possible to prevent this fermentation by means of alcohol. The six pounds of must employed yielded about one pound two ounces of syrup.

This syrup has an agreeable acidity, when diluted with water, like syrups of gooseberries and lemons. It may consequently be substituted for the fruit-syrups, which are in such general use during the heats of summer.

To take away the acids contained in the must intended to be reduced to the state of sweet syrup, various processes may be employed. We have already shewn, that it was possible, by simple decantation, to deprive it of a portion of tartar; but it is only by means of combinations that this, as well as the other acids, can be entirely destroyed.

The principal point is, to find a basis, which, combining with them, should form insoluble salts, capable of being afterwards separated from the liquor; and as tartaric acid forms an insoluble salt with lime, it may be separated by means of the latter. If calcareous carbonate or chalk be employed in this process, the only portion of tartaric acid at liberty combines with the lime; but the portion of the potash, containing the cream of tartar, (acidulated tartrite of potash,) remains combined with the tartaric acid, and forms vegetable salt (tartrite of potash). If, on the contrary, quick-lime be employed, it combines with the whole of the tartaric acid, but the potash remains dissolved in the liquor. It is susceptible of uniting with malic and acetous acids. By the addition of a greater quantity of quick-lime all the acids are indeed neutralized, but that earth is in part soluble in water as well as in the malates and acetates of lime, so that it

it is difficult to separate them from the syrup without altering the latter.

If, however, we content ourselves with saturating the acids with lime, by means of calcareous carbonate, and separate from it the tartrite of lime, we may obtain a syrup, in which some portion of the potash, of the malates, and acetates, still remains, but in too small a quantity to be perceptible to the taste. In this state the syrup of grapes is mucilaginous, and may serve for ordinary syrup, especially in the South of France, where that fruit is the more rich in sugar, the less it has of tartar; and it may become, in the hands of the industrious cultivator, an important branch of œconomy, because the preparation in question requires scarcely any time, trouble, or fuel.

For this preparation the white grape should be chosen in preference, not only because it furnishes less colouring matter and acidulated tartrite of potash than the black grape, but likewise because it appears to be preserved much more easily; for its colour, being somewhat of the nature of a perfume, is more proper for retarding the spirituous fermentation of the syrup. By adding a few aromatics, these syrups are rendered extremely pleasant; they keep well, but, like all syrups abounding in extractive matter, they are attended with the disadvantage of giving very easily, by suffering a portion of the sugar to crystallize against the sides of the bottles.

For the rest, be the nature of the grape what it may, provided it has attained the highest degree of maturity, the same kind is capable of contributing towards the existence of two syrups, distinct both in colour and taste. The first is nothing more than must deprived of a portion of tartar, and reduced to the requisite consistence; the second is the same must, into which has been put a small

quantity

quantity of chalk to neutralize the acids, and which, when clarified and evaporated to the same degree of consistence, yields a result that may be compared to syrup of sugar, having a taste somewhat resembling that of honey.

We may thus have at hand, the whole year through, a liquid sugar, which may be substituted for common sugar in the preparation of ratifias, liqueurs, acid confectionary, and acid jellies, and in marmalade of apples and pears. For this purpose nothing more is necessary than to pour a certain quantity on fruits prepared in the humid way; the lusciousness of which frequently requires to be corrected by a tartish mixture. These syrups may, lastly, be compared to those obtained from pears baked dry, which often float in a syrupy fluid, without any addition of sugar.

Syrup of Carrots.

Modern works, on rural and domestic œconomy, are filled with instructions for preparing syrup from carrots, the most saccharine root next to the skirret; but nothing can be less conformable to art, more troublesome, and more expensive than the process for preparing it indicated in them.

On examining what passes in a fleshy root, subjected to ebullition in water, it is observed that the principles that compose it are detached, as it were, in a natural state, are again united, and combine more and more, acquire softness and flexibility; and while they are boiling, one portion of the extractive matter passes into the vehicle, another adheres to the substance itself, which is defended and covered with the tissue, and a third combines with the fibrous matter.

It

It would be in vain to boil a root that has arrived at the state we call *dressed*, with a view to obtain the whole of the extractive matter it contains; the water, even after long and repeated decoctions, becomes charged with a very small additional portion; and it is reduced to the state of a fibrous skeleton, without imparting to water, aided by heat, the principles which that fluid is capable of dissolving and extracting.

It is a long time since I first asserted and proved that, to obtain all the principles of a succulent root, it should neither be boiled, nor pounded, nor rubbed, when raw or boiled; but that, after being washed in several waters, it should be grated, to tear the fibres, in which certain mucilaginous substances are inclosed as in bags.

Another condition, to which sufficient attention is not paid, in treating of syrups prepared with fleshy roots, is this. When the juice is expressed, its evaporation should not be proceeded with till it has been left to settle for twenty-four hours, and then decanted; for I have demonstrated that most of those roots contain starch, which, being converted by a certain degree of heat into jelly, would give consistence to the liquid, and would not contribute to its preservation.

Having taken three pounds two ounces of carrots, trimmed them of their leaves and their tails, and scraped off the outside of their substance, which, notwithstanding the pains bestowed on cleaning them, is commonly dirty, and impregnated with heterogeneous matter, I rasped them. This first operation being finished, they were strongly compressed in a cloth, sufficiently open to suffer the natural juice to pass. By the assistance of a pint of water I obtained a liquid product, weighing one pound two ounces, and consequently two pounds of

pulpy

pulpy residue, which I remarked to be extremely saccharine. (I might easily have deprived it of the whole of this saccharine substance by a mechanical medium, I mean by the pestle.) Having decanted this juice, and clarified it with white of egg, I evaporated it to the consistence of syrup, of which I obtained two ounces.

It should, therefore, be observed, firstly, that three pounds two ounces of carrots, expressed only by muscular strength, produce one pound two ounces of effective liquid; secondly, that it would be possible to obtain from them a much greater quantity by means of pressure, ebullition, or contusion, the actual residue still retaining a very saccharine taste.

Hence it appears, that it is easy to prepare a syrup with fruits in berries, such as grapes; but that the roots which most abound in sugar cannot, on account of their skinny and mucilaginous contexture, be so easily subjected to this preparation. The reason of this is, that whether we separate from them, by the rasp or by the press, the whole of the principles they contain, or whether they are boiled in water to extract it, the consistence of the syrup is as much owing to the extractive matter as to the concentrated sugar, and that, consequently, it is difficult to preserve such a syrup for any length of time from fermentation.

Whatever may be the mode of preparation discovered to make syrup with carrots, though the richest root in mucilaginous sugar, yet such a substitute cannot be relied on. They will always be infinitely more profitable for seasoning or food.

Chemical Experiments on Mercury.

By Messrs. BRAAMCAMP *and* SIQUEIRA-OLIVA.

From the ANNALES DE CHIMIE.

THE experiments of which we are about to give an account, have for their objects, 1, to ascertain the action of the phosphorous acid, of the phosphites, and of phosphorus, upon the oxyds and salts of mercury; 2, the analysis of some of the mercurial salts by means of the phosphorous acid; 3, the action of the super-oxygenated muriatic acid upon the red oxyd of mercury.

1. *Of the Action of the Phosphorous Acid upon the Oxyds of Mercury.*

Ten grammes of red oxyd being placed in contact with phosphorous acid a little concentrated, the colour of the oxyd was changed into a grey. On boiling this mixture, we saw, in a few instants, running globules appear, which led us to suppose that the phosphorous acid had passed into the state of phosphoric acid, by combining with the oxygene of the oxyd of mercury, but that perhaps also the phosphoric acid, as it formed, might have dissolved some portion of the oxyd of mercury. In order to ascertain this point, we filtrated and treated the liquor by sulphurated hydrogene: to our great astonishment, this re-agent afforded but extremely slight indications of the presence of mercury. The residuum that remained in the filter, after having been well washed and dried, gave us nine grammes of mercury. Hence we concluded, that the red oxyd of mercury contains nearly ten to the hundred of its weight of oxygene.

This experiment shews us a new means of analyzing the oxyds of mercury, which appears to us to be preferable

ferable to sublimation, which is not near so expeditious, and which besides is attended with the inconvenience of not giving with accuracy the quantity of the mercury reduced to the metallic state, either because it may be volatilized by some accident, or on account of the difficulty of its detaching itself completely from the vessels which are employed in this operation.

We also hoped we should be able, by means of this acid, to make the analysis of the salts of mercury, by adding potash to these, in order to decompose them, at the same time that the phosphorous acid reduced the oxyd into running mercury. However, the results of our trials were not very satisfactory; for, having followed this process upon ten grammes of oxygenated muriate of mercury, we obtained only 66 of running mercury, instead of 73, which we ought to have obtained, as we shall shew hereafter. This loss of 0,7 is to be attributed in part to what was dissolved by the phosphoric acid which was formed, but still more, in our opinion, by the potash. The mercurial salts that are decomposed by means of this alkali always retain some of it. M. Berthollet has already observed, that during the decomposition of these salts by potash, neither the great quantity of the latter, nor the ebullition, can entirely clear the solution of mercury.

2. *Of the Grey Oxyd of Mercury,*

We treated by the phosphoric acid ten grammes of this oxyd, obtained by means of a solution of sulphate of mercury at the *minimum*, decomposed by ammoniac, and strongly boiling the precipitate, in order to dissolve and separate all the triple salt that might have united with the precipitate. These ten grammes yielded us 9,25 of reduced mercury, and we concluded that this oxyd con-

 tains

tains $7\frac{1}{2}$ *per cent.* of oxygene. The means which we employed for obtaining the grey oxyd of mercury seems to us preferable to that of precipitation by the caustic fixed alkalies, which combine in part with the oxyd precipitated, from which it is impossible entirely to separate them. When, in the method with ammoniac, some portion of this adheres still to the oxyd, we may easily expel it by a moderate heat.

3. *Of the Action of the Phosphorous Acid upon the Salts of Mercury.*

Having attempted, without success, to analize the mercurial salts by means of caustic potash, we determined to treat them in a direct manner by the phosphorous acid, and we obtained the following results.

1. The phosphorous acid in excess decomposes all the mercurial salts, without exception, reducing their oxyds into running mercury, and entirely separating their radicals.

2. When these salts are at the maximum of oxygenation, it causes them to pass into the minimum before it decomposes them.

3. The reduction of the mercury to the metallic state by this means is complete, since the oxyd of mercury being united to a radical, which does not quit it entirely until it arrives at the metallic state, the phosphoric acid formed in the operation cannot dissolve the mercurial oxyd, not being in contact with the mercury until it arrives at the metallic state. The acids, before united to the oxyds of mercury, cannot re-dissolve it in presence of the phosphorous acid which destroys the action. Should a phosphate accidentally be formed, it would immediately be decomposed by the phosphorous acid.

4. Of

4. *Of the Analysis of the different Mercurial Salts.*

Persuaded from the preceding experiments, that the phosphorus acid afforded the best means of analyzing the mercurial salts, we attempted the following analyses.

Of the Turbith Mineral.

Having boiled ten grammes of this salt, very dry and well prepared, till we saw the mercury reduced, we filtrated the whole through grey paper. All the reduced mercury, collected in a single globule, weighed 7,7, which, according to the analysis of the red oxyd of mercury, is equivalent to 8,47 of the same oxyd. The filtrated liquor, treated by the muriate of barytes, gave 5 grammes of sulphate of barytes, which, at 30 *per cent.* of sulphuric acid, representing 1,5 of this acid, there remains a loss of 3 centigrammes, which may be attributed to the moisture.

This result differs a little from that given by M. Fourcroy.

Recapitulation.

Oxyd of mercury at the maximum - -	84,7
Sulphuric acid - - - - - - - - - -	15,
Loss, attributed to moisture - - - -	3
	100

Of the Neutral Sulphate of Mercury at the Maximum.

Ten grammes of this salt well dried, treated in the same manner by sulphurous acid, gave us the following result:

Red oxyd - - - - - - - - -	63,8
Sulphuric acid - - - - - -	31,8
Loss by moisture - - - - - -	4,4

Of

Of the oxygenated Muriate of Mercury of Commerce.

Ten grammes, treated by the phosphorous acid, gave us of running mercury 7,3, which represent 8,03 of oxyd at the maximum. The filtrated liquor, treated by nitrate of silver, gave 7,4 of muriate of silver, which represent 1,86 of muriatic acid. This salt being formed by sublimation, contains no water, and we attributed the 11 centigrammes loss to the iron, which is always found more or less mixed with this salt as it is met with in commerce.

Result.

Muriatic acid - - - - - - - - - - -	18,6
Oxyd of mercury at the maximum - -	80,3
Loss attributed to the iron - - - - -	1,1
	100

On the nitrous Turbith, Nitrate of Mercury at the Maximum of Oxygene, and at the Minimum of Acid.

Ten grammes of this salt, as dry as possible, treated by the phosphorous acid, gave 8 grammes of reduced mercury, which represent 8,8 of red oxyd of mercury: what is wanting to the complement of 10 grammes is to be attributed to the nitric acid, which we cannot collect in this operation, because phosphoric acid, by seizing a part of its oxygene, causes it to evaporate in nitrous vapours. The perfect dryness of the salt leads us to believe that the remainder of the weight may, without fear of error, be attributed to the nitric acid.

Result.

Oxyd of mercury at the maximum - - -	88
Nitric acid - - - - - - - - - - - -	12
	100

Of

Of the Phosphate of Mercury at the Maximum.

Ten grammes of this salt, also as dry as possible, treated in the same manner by the phosphorous acid, gave us 6,5 of running mercury, which correspond to 7,15 of oxyd of mercury at the maximum; the 2,85 which are wanting to complete the 10 grammes, we attribute to the phosphoric acid.

This experiment proves to us that the phosphorous acid not only decomposes all the salts of mercury by different acids, but also those which are formed by the phosphoric acid; so great is the affinity of this acid for oxygene, that it surmounts that of the mercury for the same principle, and at the same time the attraction of the phosphoric acid for the oxyd of mercury.

We also see clearly, by this phenomenon, the reason why the phosphoric acid, which is formed at the cost of the oxygene of the mercurial oxyds, does not dissolve the mercury as long as any phosphoric acid is present; this decomposes in its turn the phosphate which might be formed.

Of the Phosphites.

The phosphites likewise disoxygenate the oxyds of mercury, but their action is incomparably less than that of the phosphorous acid. It appears to be subordinate to the force of affinity of the phosphorous acid with its base, and to the action which this may equally exercise upon the oxyds of mercury: the phosphites therefore do not seem to us to be capable, in any case, of affording an accurate means for the analysis of these oxyds; they also disoxygenate the mercurial salts, but this action is weakened by the same causes.

Of the Action of Phosphorus upon the Mercurial Oxyds and Salts.

Pelletier, who has attempted to combine phosphorus with all the metals, says, that on treating the red oxyd of mercury with this substance by means of water, at a gentle heat, he obtained a phosphuret of mercury in which the phosphorus seems to exist in a state of feeble combination, and that he obtained by the same operation some phosphoric acid. On repeating his experiment we obtained the same results, but it appears to us that the formation of the phosphoric acid which is produced in it may be differently explained. It has appeared to us, that the phosphorus (which gives origin to this acid) attracts a portion of oxygene from the atmospheric air, and passes into the state of phosphorous acid. What has led us to form this conclusion is, that the phosphorus which is carried off by the vapours of the water, burns at the surface of the latter; and that it consequently forms there phosphorous acid, which must be changed into phosphoric, in proportion as it seizes the oxygene from the red oxyd of mercury. This explanation appears to us the more natural, as phosphorus, placed in contact with the red oxyd, does not become acidified, though it disoxygenates the latter, as we shall shew hereafter, and as phosphorus boiled in water is changed, by this simple operation, into phosphorous acid.

When phosphorus is placed in contact with red oxyd and water in the cold, it first attracts oxygene from the red oxyd, and reduces it first of all into grey oxyd, and at length to the metallic state; but in this case no phosphorous acid, nor phosphoric acid is formed; the phosphorus merely becomes oxydated, and assumes a dark colour. It is not difficult to conceive the theory of this

phenomenon?

phenomenon: the phosphorus, having great avidity for oxygene, separates it from the oxyd with which it is in contact; but this combustion is so slow, as is proved by the uniformity of the temperature of the liquor during the operation, that the phosphorus is never in a condition to seize upon the portion of oxygene required for its conversion into the acid state. The reduced mercury cannot combine with the phosphorus; for, as it does not combine with it when in the state of fusion, (according to the experiments of Pelletier,) it is still less capable of combining with it when in a solid state, and without any change of temperature.

Our experiment may perhaps furnish the means of obtaining the true oxyd of phosphorus, which hitherto has been little or not at all known.

The mercurial salts are equally decomposed and deprived of their oxygene by phosphorus, with the application of heat as well as in the cold; but in the first case, a phosphuret of mercury is formed, which consequently prevents its analysis by this means. It might perhaps be accomplished in the cold, but the action is so slow, that any other more expeditious means would be preferable to this.

Of the Action of the oxygenated Muriatic Acid upon the Red Oxyd.

This subject has formerly been treated by Messrs. Fourcroy and Thenard, and it may easily be supposed that such able chemists have left little to be done in a field which they have already cultivated. We have obtained nearly the same results which they have indicated, and we return to this subject merely in order to notice some slight peculiarities which have escaped them.

Experiment I.

We put 50 grammes of red oxyd of mercury into a proportionate quantity of distilled water, and caused oxygenated muriatic acid gas to pass into it, taking care to agitate the liquor well, in order that the gas might come perfectly into contact with the red oxyd. After the space of an hour, the colour of the oxyd began to change, becoming darker every moment; we continued to cause gas to enter till the brown powder had deposited itself; we then decanted the liquor, washed and filtrated this powder, which had become of a deep violet colour; and after being dried it weighed 29 grammes. The evaporated liquor presented to us a salt crystallized in the form of needles, which we ascertained by the re-agents to be super-oxygenated muriate of mercury; the last liquor, after the crystallization, presented to us slight traces of another salt more highly oxygenated than the preceding, but its quantity was too small for us to subject it to any experiment.

The violet powder, which has hitherto been considered as an oxyd of mercury, more or less oxygenated, being subjected to different experiments, gave us the following results:

1. Boiled in water, it was found insoluble in it, and did not in the least changes it colour.

2. Treated with caustic potash, it was converted into red oxyd, and the liquor contained muriatic acid; there existed therefore in this powder a muriate of mercury.

3. In order to determine the nature of the latter, and to ascertain the proportion in which it was contained in it, we sublimed 10 grammes of this powder, and obtained

2 grammes

2 grammes of sublimed muriate, and 8 of red oxyd not sublimed. The sublimed muriate dissolved almost entirely in the muriatic acid, and the extremely-small portion which did not dissolve was mild muriate.

Hence it follows, that the violet-coloured powder which is formed by the action of the oxygenated muriatic acid upon the red oxyd of mercury, is not a simple oxyd of mercury, but an oxygenated muriate of mercury, with a great excess of red oxyd of mercury, in the proportion of 2 to 8; that this great excess of oxyd is combined with the salt; at least this seems to be proved by the first experiment, since boiling water was not able to separate the muriate of mercury from the red oxyd.

Experiment II.

From all the circumstances of which we have just given an account, we concluded the possibility of forming a super-oxygenated muriate of mercury, of a degree superior to that of corrosive sublimate. As the action of the oxygenated muriatic acid had not given us in the cold so satisfactory a result as we wished, we boiled 30 grammes of red oxyd of mercury with oxygenated muriatic acid, taking care to add fresh quantities, in proportion as it was absorbed by the substance. When this refused to absorb any more, the liquor was decanted, and the powder washed and dried: the quantity of the latter was nearly the same as in the former experiment; treated by the same re-agents it gave us similar results, and by sublimation it yielded the same proportions.

The liquor being properly evaporated, it yielded oxygenated muriate of mercury perfectly crystallized. The last portions of the liquor not presenting any appearance of crystallization, were evaporated to dryness, and

 presented

presented to us what we sought for, a super-oxygenated muriate of mercury, possessing the following properties:

1. It is highly soluble and deliquescent.

2. Much more soluble in alcohol than the ordinary oxygenated muriate.

3. It decrepitates with the concentrated sulphuric acid, assumes a yellow colour, and disengages oxygenated muriatic oxyd gas.

4. The essential property, which no other salt besides this is known to possess, is, that being mixed with the sulphuret of antimony, it inflames spontaneously at the ordinary temperature, some instants after the mixture is made. The residuum of this combustion, besides the sulphuric or sulphurous acids which are disengaged, consists of oxygenated muriate of mercury (corrosive sublimate) and muriate of antimony. It appears, therefore, that, in this case, the superabundant oxygene of the super-oxygenated muriate, burns a portion of the sulphur, and produces the sulphuric acid, and a portion also of the antimony which then combines with some of the muriatic acid from the mercury.

This salt, however, possibly on account of its extreme deliquescence, does not decrepitate upon ignited coals, nor does it make any explosion under the pressure of the hammer.

The oxyd of mercury which is combined in this salt is of the same nature with that which is combined with the oxygenated muriate. The alkalies likewise precipitate it in a yellow oxyd.

Conclusion

Conclusion from the last Experiments.

The oxygenated muriatic acid produces, therefore, with the red oxyd of mercury, principally by the acid of heat, different kinds of salts.

1. Muriate of mercury at the maximum, with a great excess of oxyd, resembling the turbith mineral as to its insolubility in water, but reducible by sublimation into oxygenated muriate of mercury, and into red oxyd.

2. Simple muriate of mercury. This salt accompanies, in small quantity, the preceding salt.

3. Oxygenated muriate of mercury, which crystallizes by the evaporation of the liquor.

4. Super-oxygenated muriate of mercury. This salt is extremely soluble and uncrystallizable.

Such are the remarks which we had to offer respecting the action of the phosphorous acid, and the oxygenated muriatic acid, upon the mercurial salts and oxyds. Justice requires that we should acknowledge the advantage which we have derived in our researches from the practical skill and chemical sagacity of M. Paumier, who has assisted us in our labours, and shared in our solicitude to give them all the requisite accuracy.

Conjecture.

Before we conclude this memoir, we beg leave to offer a conjecture to which this inquiry has given rise. We feel the less reluctance in presenting it, as it refers to a point which, in the present state of our knowledge, cannot yet be a subject of reasoning in the proper sense of the term.

It is well known that mercury, in the state of oxyd or of salt, is employed in medicine for the cure of venereal disorders.

disorders. The effects of this remedy are well known, but its mode of action is far from being so. Does it act by forming a combination with the principle of the disease, or by yielding to it its oxygene, and being reduced itself to the metallic state? The latter opinion, which has some facts to support it, seems the most probable. The experiments of which we have just given an account, persuade us, that of all the substances which the mercurial oxyds and salts may meet with in the animal economy, none can take from them their oxygene so easily as the phosphorous acid or the phosphites.

Some perhaps may tell us, that there may exist in the animal liquids alkalies or alkaline earths capable of decomposing the mercurial salts, and separating their oxyds. We shall only answer, that the alkalies do not exist in the caustic state in these liquids, and that consequently their radicals cannot by the double affinities combine with the oxyds of mercury; and that, even though the oxyd of mercury should be in this state, a substance would still be required that could carry away its oxygene. It is possible that such substances may be discovered in the human body; but we do not know of any which possesses the property of seizing the oxygene from the oxyds of mercury in a degree at all compatible to the phosphorous acid and the phosphites. It is known, that a large quantity of phosphoric acid is contained in the human body: of this the phosphate of lime which constitutes the bones is a proof. It is easy to conceive the formation of the phosphorous acid and the phosphites in the human body, since the phosphorous acid in reality is nothing else than phosphoric acid, with an excess of phosphorus. We conjecture, however, that the formation of the phosphorous acid and of the phosphites might perhaps be supported by the following observations: 1, that the malady in question

question has its origin in the contact of the fecundating parts; 2, that phosphorus performs a principal part in the functions of reproduction. Pelletier has remarked, that phosphorus is the most powerful aphrodisiac known; analysis has shewn that the crystals of the human semen are phosphate of lime. Phosphorous acid and phosphites would therefore vitiate the spermatic liquids, which would not be restored to their natural state until the phosphorous acid and the phosphites, seizing oxygene from the mercurial oxyds, should return to the state of phosphoric acid and of phosphates, such as they are found in the state of health.

Note of M. VAUQUELIN.

It is not necessary to have recourse to the presence of the phosphorous acid or of phosphites in the animal liquids, which is by no means proved, in order to explain the reduction of the salts and oxyds of mercury, since almost all the animal humours produce this effect.

Intelligence relating to Arts, Manufactures, &c.

(Authentic Communications for this Department of our Work will be thankfully received.)

New Method of preparing Ceruse in the large Way.

TAKE any quantity of lead-ashes, and dissolve them, by the aid of gentle heat, in a sufficient quantity of dilute nitric acid. Filtrate the solution, and precipitate it by decanted chalk. The precipitate, washed and dried, gives the purest and most beautiful ceruse which can possibly be seen.

List

List of Patents for Inventions, &c.

(Continued from Page 320.)

William Wilkinson, of Needham-Market, in the county of Suffolk; for improved pan-tiles for covering houses and other buildings. Dated August 9, 1805.

William Collins, of Plymouth, in the county of Devon, Esquire; for a ventilator, for the purpose of ventilating close carriages of every description, sedan-chairs, rooms, and cabins of ships, and by which sound may also be conveyed for certain useful purposes. Dated August 9, 1805.

William Scott, of the London Glass-Works, East Smithfield, in the county of Middlesex, Glass-manufacturer; for improvements in the manufacturing and working of various kinds of glass. Dated August 9, 1805.

Thomas Johnson, late of Stockport, in the county of Chester, but now of Preston, in the county of Lancaster, Weaver, and James Kay, of Preston aforesaid, Machine-maker; for a new and improved machine or loom for weaving cotton and other goods by power. Dated August 9, 1805.

Thomas James Pluckkett, of Butt-lane, Deptford, in the county of Kent, Gentleman; for a new method of mowing corn, grass, and other things, by means of a machine moving on wheels, which may be worked either by men or horses. Dated August 23, 1805.

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

No. XLII. SECOND SERIES. Nov. 1805.

Specification of the Patent granted to William Kent, *of the Borough of Plymouth, in the County of Devon, Merchant and Agent; for Additions and Improvements on a Sort of Candlestick (in common Use), as will be found to prevent accidental Fires in the Use of Candles.*

Dated July 2, 1805.

With an Engraving.

To all to whom these present shall come, &c. Now know ye, that in compliance with the said proviso, I the said William Kent do hereby declare, that my said invention is on a candlestick, marked Number 1, in the margin; and the additions and improvements therein are described in Number 2, and are as follows. *a*, (Plate XIX.) addition of water. *b*, rim, by which it may be conveniently removed with the water therein. *c*, guard, to be made of glass or horn, of an height according to the use the candlestick is intended for; which, without destroying the light, conducts the sparks into the water, and also prevents the danger of curtains, cloaths, or other articles communicating (sideways) with the candle. The guard is

is made to take off occasionally, as is also the wire on which it slides. *d*, conical socket, in which (slide or lifter is avoided) that the candle may on its burning down to the socket meet with no obstruction in instantly dropping into the water, and be thereby quite extinguished (though the parties may have fallen asleep). *e*, hole in the socket to admit the water, and also to take out the end of candle that drops in. To the candlestick is added a pair of snuffers and an extinguisher. These candlesticks may be made of silver, brass, copper, tin, or other materials, of various sizes, with one or more sockets, for use on board of ships, in shops, warehouses, and other places.

The plan marked Number 2 is taken from one manufactured of tin, but may be made of silver, or other materials (except tin), with sides, round, or otherwise shaped.

In witness whereof, &c.

Specification of the Patent granted to THOMAS ROWNTREE, *of Surrey-street, in the Parish of Christ Church, in the County of Surrey, Engine-maker; for a new Improvement in the Construction of Water-Closets, and which may be applicable to other useful Purposes.*

Dated December 13, 1790.—Term expired.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Thomas Rowntree do hereby declare, that my said invention of a new improvement in the construction of water-closets, and which may be applicable to other useful purposes, is described in manner following; that is to say: My invention or improvement in water-closets consists of such a disposition or application of the several parts necessary to compleat the same, that the whole apparatus

paratus is capable of being moved together, and is what I term my portable water-closet. The whole apparatus of this closet may occasionally be removed from one place to another without taking to pieces, and has all the advantages in respect to the prevention of the ill smell or stench which is found in fixed water-closets. It may be made for the purposes of sick rooms, and on such a scale as not to occupy more space, or to be more incumbrance than a common night-chair. In my closets of this kind the reservoir for the water (which may either be hot, cold, or medicated) is fixed in the same piece of furniture as the basin and soil receiver; which latter is so fitted to the soil-pipe from the basin, that it may be taken away and replaced at pleasure. The stench is prevented from getting out of the receiver, by means of the soil-pipe from the basin forming an air-tight junction with it, either by having the end of the pipe immersed in water or some proper fluid, or otherwise made close by flanches, insition, &c. This secures it on the outside of the basin. The stench is prevented from getting through the opening of the basin by any of the water-stops or stink-traps at present in use; or by the application of my new-invented circular sliding-valve, which has the properties of both a valve and cock, and is made to perform its office either by moving all round each operation, or to pass one part of the way, and return in such a manner as to open and shut the communication between the basin and soil-pipe, and give an opportunity for the soil and water to escape into the soil-receiver. The same operation, when required, feeds the basin with a supply of water from the reservoir; or otherwise the basin may be supplied from a separate vessel, either by passing the water through the reservoir or applying it directly to the basin. Another improvement in water-

closets, is the application of the basin and soil receiver, as before described, but with a separate reservoir, where it may be more convenient to have the closet in two or more pieces of furniture instead of one, or where it might be required of a larger size. Another improvement in a water-closet is the application of the basin and circular sliding-valve, either with a fixed or separate reservoir, to a common receiver or cess-pool, by taking away the receiver as described, and joining the soil-pipe to such common receiver or cess-pool, and by that means have all the useful properties of the most expensive water-closets.

In witness whereof, &c.

Specification of the Patent granted to CHARLES HOBSON, *of Sheffield, in the County of York, Plater, and* CHARLES SYLVESTER, *of the same Place, Chemist; for a Method of manufacturing the Metal called Zinc into Wire, and into Vessels and Utensils for culinary and other Purposes.* Dated April 29, 1805.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Charles Sylvester do hereby describe and ascertain the nature of our said invention, and the manner in which the same is to be performed, as follows; that is to say: The discovery made by us, upon which the processes of our said method are grounded, and so essentially depend, is, that zinc (which has heretofore been called a semi-metal, because it is not malleable, and scarcely capable of extension, by mechanical means, at the ordinary temperature of the atmosphere, or at those heats which are usually applied in forging or extending the metals called entire metals) is capable of being extended

tended by hammering, laminating, wire-drawing, pressing, stamping, or by the other well-known methods of treating the entire metals, provided the said zinc be kept during the said operations at or about a certain heat, determined by experiment first made, and often repeated by us, and hereafter to be mentioned. Or provided, in other cases, the said zinc shall have been annealed by exposure to such a degree of heat as aforesaid. Our operations are accordingly conducted and performed as follows, or nearly so, with variations according to circumstances, or to the sizes or kinds of things required to be made; which variations are such as any workman accustomed to the treatment of other metals will easily ascertain and adopt. We cast our zinc into ingots or thick plates, in the usual manner, of such a figure and magnitude as may best suit the intended purposes, and the best form for making of wire is that of a cylinder. These ingots or pieces, when intended to be mechanically wrought or worked, are then to be heated to a temperature between the degrees of 210 and 300, or thereabouts, according to the scale of Fahrenheit, which may be effected by placing the same in an oven duly heated, or by any other well-known method. For wire, it is most convenient, that the cast cylinders be extended between rollers, at the above temperature, till their lengths have been increased to about four times; and afterwards the same may be drawn through the wire plates without farther heating or annealing, unless the pieces should be very thick: and in the whole operation the usual care and attention must be taken, and had to chuse that series or course of holes which shall duly extend the wire without forcing or breaking it. Plates of zinc may be made by working it from the ingot or piece between rollers, at the temperature aforesaid; and those plates may be hammered

mered up into vessels, for culinary and other purposes, by the same treatment as is applied to other metals, taking care, when the size or form, or other intended requisites of the vessels require it, to heat or to anneal the zinc at proper times during the operation. Utensils of every description may be stamped, forged, or otherwise made and wrought, of zinc, during its malleable state, at the temperature aforesaid, or after the annealing discovered, and herein mentioned and described. Lastly, whenever it is necessary to unite pieces or plates of zinc together, we perform the same by the use of a solder, consisting of two parts tin and one part zinc, or thereabouts, more or less, according to the hardness and fusibility required in the same; or otherwise the common glaziers solder may be used and applied for the same purpose.

In witness whereof, &c.

Specification of the Patent granted to THOMAS CHAPMAN, *of Witham in Holderness, in the County of York, Thrashing Machine-maker; for a Mill for tearing, crushing, and preparing Oak Bark, to be used by Tanners, in the Process of tanning Hides.*

Dated July 29, 1805.

With a Plate.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Thomas Chapman do hereby, and by the plans or drawings hereunto annexed, particularly describe and ascertain the nature of my said invention, and in what manner the same is to be performed, as follows; that is to say: That the mill may be worked by steam, wind, water,

E

water, or by one or more horses; and that the rag-wheels may be made of any kind of metal most suitable. And the description of the annexed plans, which are for a mill to be worked by a horse or horses, is as follows.

Fig. 1, (Pl. XIX.) A, is the horse-wheel. B, the tumbling-shaft, which unites with the barrel-gudgeon E. C, is the frame to contain the three barrels D E F. D, is the spike-roller, which keeps the rag-barrel E clean. E, is the rag-barrel, with twenty rows of plates, or more, according to the power required. F, is the small barrel, which turns the contrary way to the barrel E, and gathers the bark, and likewise holds it fast by having the points upwards whilst the barrel E is tearing it to pieces: the barrel E goes round considerably quicker than the barrel F. G, is a fly-wheel, which is turned from a wheel fixed upon the gudgeon of the barrel E, to keep the mill in a steady motion. H, is the cylinder to separate the ground or torn bark, as more particularly mentioned in the description of Fig. 2, hereinafter given. I, a basket, into which the bark when torn is supposed to fall. *h h*, are two screws to regulate the barrel F, and make it grind finer or coarser; *viz.* to grind finer turn the screws to the right hand, and to grind coarser the reverse way. *i*, is a screw, to regulate the bottom plate *f*, in Fig. 3, for the like purpose, by turning the screw in like manner as the screws *h h*.

Fig. 2 shews a side-view of the grinding-part, and likewise of the cylinder A, with the spout B; which spout conveys the bark when torn into the cylinder A. C, is a bin, to receive the finest dust from the cylinder. D, a bin to receive the coarser dust, usually called hand dust. E, is the basket to receive the bark when torn; but a bin or other contrivance for receiving the bark may be substituted for the basket.

Fig.

Fig. 3 shews the wheels and the grinding-plate, and how they work. *a*, the spike-roller, which cleans the barrel *b*. *b*, is the large barrel, and *c* the small one. *d*, the regulating-screw for the small barrel *c*. *e*, the regulating-screw for the plate *f*. *f*, is the grinding-plate, which takes the bark after it has passed the barrrels *b* and *c*. And *g* is the spout which conveys the bark into the cylinder A, in Fig. 2.

Fig. 4 shews the front edge of the barrels, and how they work one within the other, as at *a*. They may be set so as to grind as fine or as coarse as the workman shall chuse.

In witness whereof, &c.

Specification of the Patent granted to PETER MARSLAND, *of Heaton Norris, in the County of Lancaster, Cotton-spinner; for a certain Improvement in the Process of dying Silk, Woollen, Worsted, Mohair, Fur, Hair, Cotton, and Linen, or any one or more of them, as well in a manufactured, or part-manufactured, as in an unmanufactured or raw State.* Dated July 19, 1805.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said recited proviso, I the said Peter Marsland do hereby declare, that the nature of my said invention, and the manner in which the same is to be performed, is as follows.

The Nature of the Invention.

My invention consists in the extraction of the air from a vessel containing the silk, woollen, worsted, mohair, fur, hair, cotton, and linen, which are to be dyed, or any one or more of them, as well in a manufactured, or part-manufactured, as in an unmanufactured or raw state,

and

and consequently from such silk, woollen, worsted, mohair, fur, hair, cotton, and linen, or any one or more of them, and applying all, or any of such liquid materials or substances as are used in dying the same, or any one or more of them, to the same, or any one or more of them, while the air is so extracted therefrom. The more completely the air is extracted, the more perfect the operation will be.

The Manner in which the same is to be performed.

The articles which are to be dyed must be put into a vessel called a receiver, and which must be perfectly air-tight, by fastening down the lid or other cover to the aperture through which the articles are put into the receiver; then, by means of a common air-pump, connected with the receiver, or any other means by which a vacuum may be produced in the receiver, the air must be extracted from the receiver, and from the articles which are to be dyed contained in it, or as much of such air as can be easily extracted; then such of the liquid materials, or substances as are commonly used in dying the same, are to be introduced into the receiver, either at the same time, or at different times, according to the order in which the same are used in the common process of dying, care being taken that no air, or as little air as possible, be admitted into the receiver. The articles to be dyed are then to remain in such liquid materials or substances as are contained in the receiver, until they are sufficiently saturated or impregnated therewith. A lid, grating bars of wood, or other solid substance, must be placed within the receiver, at the distance of a few inches from the top thereof, to prevent the articles which are to be dyed from rising above the surface of the liquor.

In witness whereof, &c.

Method of rendering useful burnt Materials, or the Articles remaining after Public Fires.

By Mr. MATTHEW GREGSON, *of Liverpool.*

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Gold Medal was presented to the Author of this Communication, and Specimens of the Application of the burnt Materials to various Purposes, referred to in this Account, are placed in the Society's Repository for the Inspection of the Public.

FEELING as I do for the sufferings of many of my townsmen and friends, on account of the dreadful fires that have lately happened in Liverpool, I am anxious to make myself useful to them, and not unworthy of the notice and regard of the Society for the Encouragement of Arts, &c. I had the honour to be introduced to this Society by a friend, in the year 1801, and was much gratified by the laudable public spirit which that Society displays in promoting the interests of mankind. Upon being presented, at their Meeting, with a piece of paper made of *straw* or *paut*, I was greatly impressed with an idea, of *how much might be made of many articles apparently of no value*. This idea I have never lost sight of since, and in consequence of it now trouble you with these papers.

I was not present at the dreadful fire in Liverpool, in September last, when so many large warehouses were burnt to the ground, and the greatest part of their contents destroyed to an immense amount, as will be shewn hereafter; but I have herewith enclosed as correct a list

as

as I could obtain, and I believe nearer the truth than any that has yet been made public.

I returned home about ten days after the accident; the ruins yet smoking, and the articles still burning. The first time I went to the spot I collected the following specimens, a part of which accompany this letter. I wish I had collected a greater quantity; but the present will, I trust, be sufficient to establish the facts I have to offer.

No. 1, is burnt Sugar, marked S. B. or Sweet Black.
2, is burnt Wheat, —— V. B. or Vegetable Black.
3, is burnt Rice, —— R. B. or Rice Black.
4, is burnt fine American Barrel Flour.
5, is burnt Cotton.

These are accompanied with an account of the amount and sales of the damaged articles of every description, which produced, as nearly as can be estimated, 13,050 *l.* 2*s.* 0*d.*

I have likewise attempted an estimate of what might have been still farther saved to individuals, and to the public, to Insurance Offices, &c. &c. if the plan I have since formed had been then adopted. On the article of grain only, I estimate the saving to be forty-four thousand pounds more than was recovered, which is far more than three times the sum on this one article alone; and I conclude this saving to be nearly as much again upon rice, sugar, melasses, cotton, coffee, hemp, &c.

Fully impressed with this idea, I wish to make known for the public benefit, through the medium of this honourable and distinguished Society, to whom artists, manufacturers, agriculturists, and the commercial world owe so much, my invention for converting those ruins after a fire to the most useful purposes, preferring, as I do, any honorary reward the Society may confer upon

 me,

me, to any pecuniary emolument which I might obtain by the concealment of a simple experiment.

The simplicity of the conversion of a useless to a valuable article will be highly approved, as I conceive, by the Society. It will require but few words to explain it; for, like the egg experiment of Columbus, it need but be pointed out to be understood. That it was not thought of before, is to me astonishing; and I very much wonder, that hundreds who saw the ruins did not attempt something for the recovery in part of this valuable property, which was consigned to the dunghill, or carried away by the tide.

No. 1. The burnt sugar was reduced to a fine powder, and was tried as a water-colour paint. A specimen is enclosed, marked at the corner SB. As a *varnish ground* it is used, and marked S B; but as an *oil colour* it is used upon mahogany, and the sample marked S. It was again tried as a *printing-ink.* Specimens of this also are enclosed, and of a wood-cut of Bewick's, with a dedication to the Society.

No. 2. Burnt wheat was only reduced to a fine powder. *Water-drawing* is marked V B. *Varnish colour* is grounded, marked on the back V B. Oil colour marked V on mahogany; and as a printing-ink marked V B.

My painter, not having the least knowledge of what he was using, gave it as his opinion, that either of them is preferable to ivory or lamp-black; that they have a good body in oil, and spend freely in water.

He likewise farther states, that the vegetable black, as I call it, is of a stronger body, and, of the two, is the best black in oil, being a solid good colour, and drying very rapidly. He prefers the S B, or sweet black, in varnish; and in water he conceives it to be a better, warmer, and richer colour, than any Indian ink he ever

used;

used; and it much resembles that article, working full as freely, and spending equally well.

Among these specimens, that marked R B dries better than that marked V B. There are also larger specimens of that article sent, these having been collected from a later fire than the Goree fire.

No. 4 is a specimen of American fine flour, which when dug up was in the form of a cask, the same being burnt, and the flour left brown. The first piece I saw I thought was stone. I have converted a part of it into brown powder for hair, which is not very fashionable at present, or it would have answered. However, contrary to my expectations, on pounding it fine, and boiling it in water, I find it makes an excellent paste. It will also answer all the purposes of paste for manufactories. This was really quite contrary to my expectations. I have pasted some tea-paper over an old newspaper, and enclosed it, which will prove my assertions to be good.

Some of the grain was not sufficiently burnt, for it fermented when carried to the dunghill; but I have no hesitation in affirming, that the timber and charcoal on the premises was sufficient to have calcined the whole of the grain in a manner suitable for a basis for black *water colour*, *varnish-black*, *black oil colour*, or *printing-ink*, to all which purposes the materials are so very applicable, and so easily converted.

That corn, when charred, is incorruptible, is a fact that was known to the Antients; and if so, there can be little doubt but the colour will be durable. It is not in my power to say, whether it may be used for dyeing; but I am inclined to think that the Chinese make Indian ink of rice, or some vegetable black.

I have yet made no experiments on the cotton, being so actively employed in my own business. I have sent a sample,

sample, and have some intention of trying how far I can succeed with that, and rice, which I have tried in water colour only.

I have sent by Higginson's waggon, on the 21st inst. fourteen lbs. of burnt rice, also some sweated rice, and burnt cotton; the first, I am informed, will cost at the utmost 8*s.* *per* cwt. for grinding. Manganese is ground here for the bleachers use, at 30*s.* *per* ton, which I presume is a harder substance. I have enclosed you a sample of manganese so ground.

My painter tells me, that for the representation of oak, he knows no colour equal to B, without any figuring or dashing of which, as a glazing colour upon a white ground, it is very applicable.

This will be best exemplified by a sample painted on a board marked B, on which there are three patterns painted, all produced from burnt rice, more or less burnt, or more or less covered on.

R B is rice black, S B is sugar black, V B is wheat black, the plain board is V B varnished, and Mr. Thomas Gill's letter accompanies the board; he made the water sketches I before sent, but knows not the composition of any of the colours. We have frequent cargoes of grain and flour destroyed, or rendered of little value, in long voyages, by heating; the value of these may be increased by a conversion to these useful purposes, and the drying quality will recommend their use, as lampblack is much objected to for being a slow drier.

The following letter was received by Mr. Gregson from Mr. Thomas Gill, of Feather-court, Richmond-row, Liverpool, and transmitted to the Society.

"Having made the necessary trials in oil and varnish, with the samples of black you sent me for that purpose,

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it appears to me, that the black marked V B on the pattern-board is the best both in point of colour and quickness of grinding. In strength of colour it equals the ivory-black now in use, and is superior to the lamp-black; with regard to body, it is much greater than the former, and at least equal to the latter colour; it likewise dries well, and will be perfectly hard in eight hours with good boiled oil; in this point it is superior to the lamp-black, the latter being a very slow drier, and occasioning much trouble to the consumer; in short, when well pulverized and cleansed, it will, in my opinion, prove a great acquisition to the trade, provided it can be manufactured cheap enough to come into general use. The other blacks, S B and R B, possess nearly the same properties, but are deficient in colour; they might, however, come into use as preparatory colours to any dark-coloured work. The brown appears capable of a still farther improvement by sifting, washing, &c. as it contains gritty particles, that render it very difficult to grind; and when ground and spread out by the brush, these particles are visible on the surface, which gives it a sandy appearance. It can only be made use of as a glazing colour, owing to want of body; it has, however, a good drying quality, and might often be substituted for the Terra de Sienna, when cleansed from the particles alluded to above.

I have likewise made trials of the blacks as water-colours, and find the S B preferable to the rest; it is a very good warm colour for a wash, and works very free. For mellowness of tint, I think it equal to Indian ink.

The brown is also an excellent wash, of a good tint, working very fine; but seeming to want strength, it may be improved in this way, when cleared from the sandy particles

particles mentioned above, as they at present hurt its lustre, and diminish its strength."

Certificates were also received from Mr. W. Redmore Bigg, No. 123, Great Russel-street; stating, that he had sent a slight painted sketch as a specimen of it; that it appears to him a strong and deep black, and he thinks stronger than ivory-black; that it works free, and produces a clean and clear colour with white, and no doubt will work equally well with other colours; that he has used the drying oil with it, and it dries very well.

From Mr. J. B. Brooks, No. 21, Old Bond-street; stating, that having printed some paper in the usual manner of paper-staining in size, with the simple black marked V B, he found it to be a better colour than blue-black or lamp-black, which are generally used, and he thinks it will answer better for printing than either; has sent some of the paper printed with Mr. Gregson's sample.

From Mr. John Tootle, paper-stainer; stating, that the vegetable-black, sent him by Mr. Gregson, would answer every purpose for a black in their manufactory, and particularly so for laying grounds for black borders; as it has more body than lamp-black, and will cover the ground with one colouring, but that with lamp-black they are obliged to colour twice.

From Mr. Henry Buckley, No. 161, Strand; stating, that on trial of the black produced from burnt wheat, he found it to possess a much stronger body than the generality of blacks now in use; and that it has an additional valuable property of drying without any other auxiliary than the boiled oil in which it is ground; that this quality adds considerably to its utility, as the com-

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mon blacks are frequently dried with great difficulty, even with two or three chemical dryers, and the use of boiled oil in addition.

Some farther remarks and calculations were added by Mr. Gregson, to shew that burnt grain will answer the purposes of charcoal in various smelting works, and that the burnt grain carted from Goree fire, at Liverpool, which sold for only 322 *l.* 14 *s.* would have produced 10,000 *l.* if applied to the uses of charcoal.

Description of a Forge-Hammer, with great Power for working Metals, to be worked by one or more Men occasionally. Invented by Mr. GEORGE WALBY, *of Goswell-street.*

With a Plate.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Silver Medal and Forty Guineas were voted to the Inventor.

I TAKE the opportunity of laying before the Society a drawing, accompanied with a description, of a new-invented hammer, for the purpose of forging bricklayers trowels, rounding of ships bolts, beating gold or tin foil, planishing brass, copper, &c. or for any other work in which a large hammer may be required upon a simple principle. The weight of the hammer is seventy pounds, which may be worked by one man, with the speed of three hundred blows *per* minute, with the greatest accuracy and ease, and it performs the work of two or three men. The steel is kept in better temper by this hammer, as it requires fewer heats in doing the same work than in the common way.

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The trowels made by me with it will bear any pressure of bending, and return by their elasticity to their original shape, and they will even cut a chip from a bar of solid iron, without hurting their edge; they are lighter and more handy than common trowels, and serve much longer in use.

Reference to the Engraving of Mr. Walby's Hammer-plate. Plate XX. Figs. 1 and 2.

Fig. 1, A, a block of oak, in which the hammer acts. B, the wheel or nave, in which the hammer-handle C is fixed, also the chains which give motion to the hammer by the quadrant D. E E, are the two levers which work the quadrant D. F F, are the two pedals on which the man who works the machine treads alternately, holding the levers E E in his hands; when he treads on the right pedal F he lifts the hand-levers E E, which motion raises the hammer C; when he treads on the left pedal, he presses on the same levers, which motion lets fall the hammer. G, is a rack, which moves perpendicularly by the action of a strong wooden spring H, placed in a trough underneath the centre of the machine; the rack is kept close to the quadrant K by a bridge *a*, containing a small friction-roller. I, an additional steel spring, fastened to the cieling over the machine, in order to assist the wood spring H, when fewer hands are at work. K, is the quadrant contained in the centre of the oak block A, under the nave B, which assists in raising or depressing the hammer by the alternate actions of the pedals F F. L, is a lever fixed on the axis of the quadrant K, which, at the time it depresses the rack G, pulls upon the hammer-handle C, by the chain M, which adds to the power of the blow. N O, are the

two

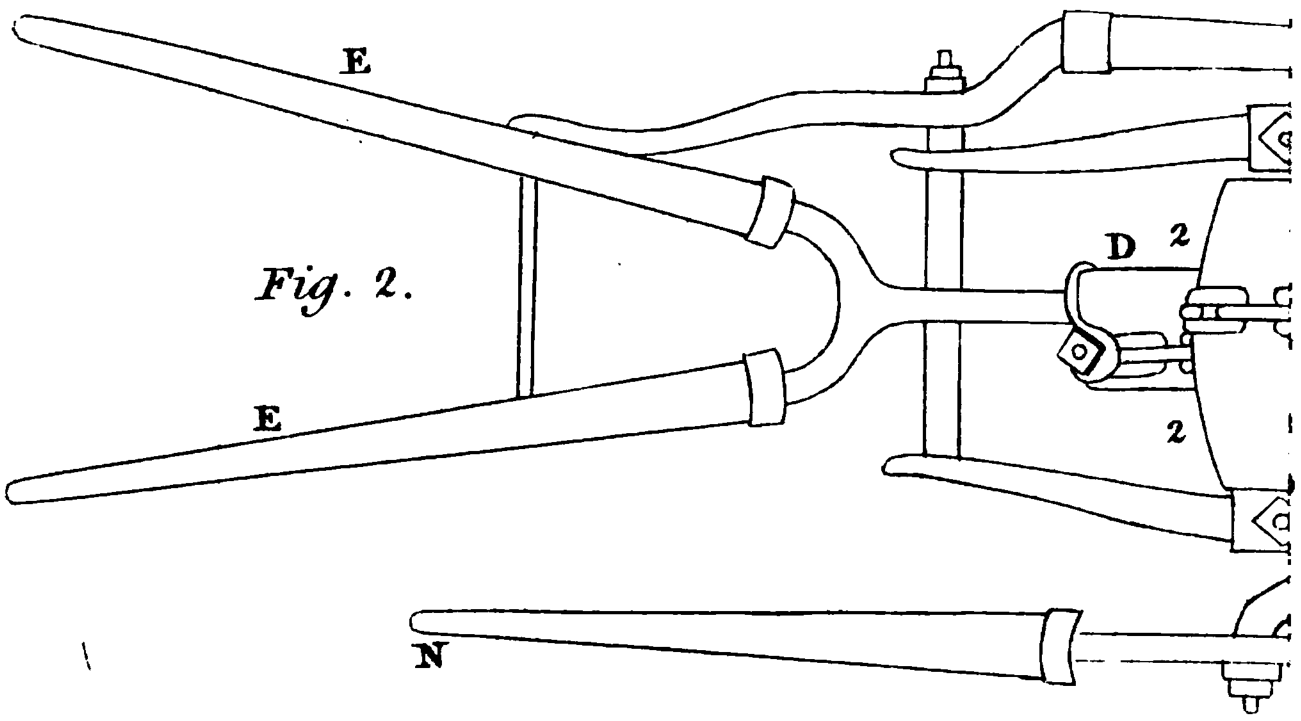
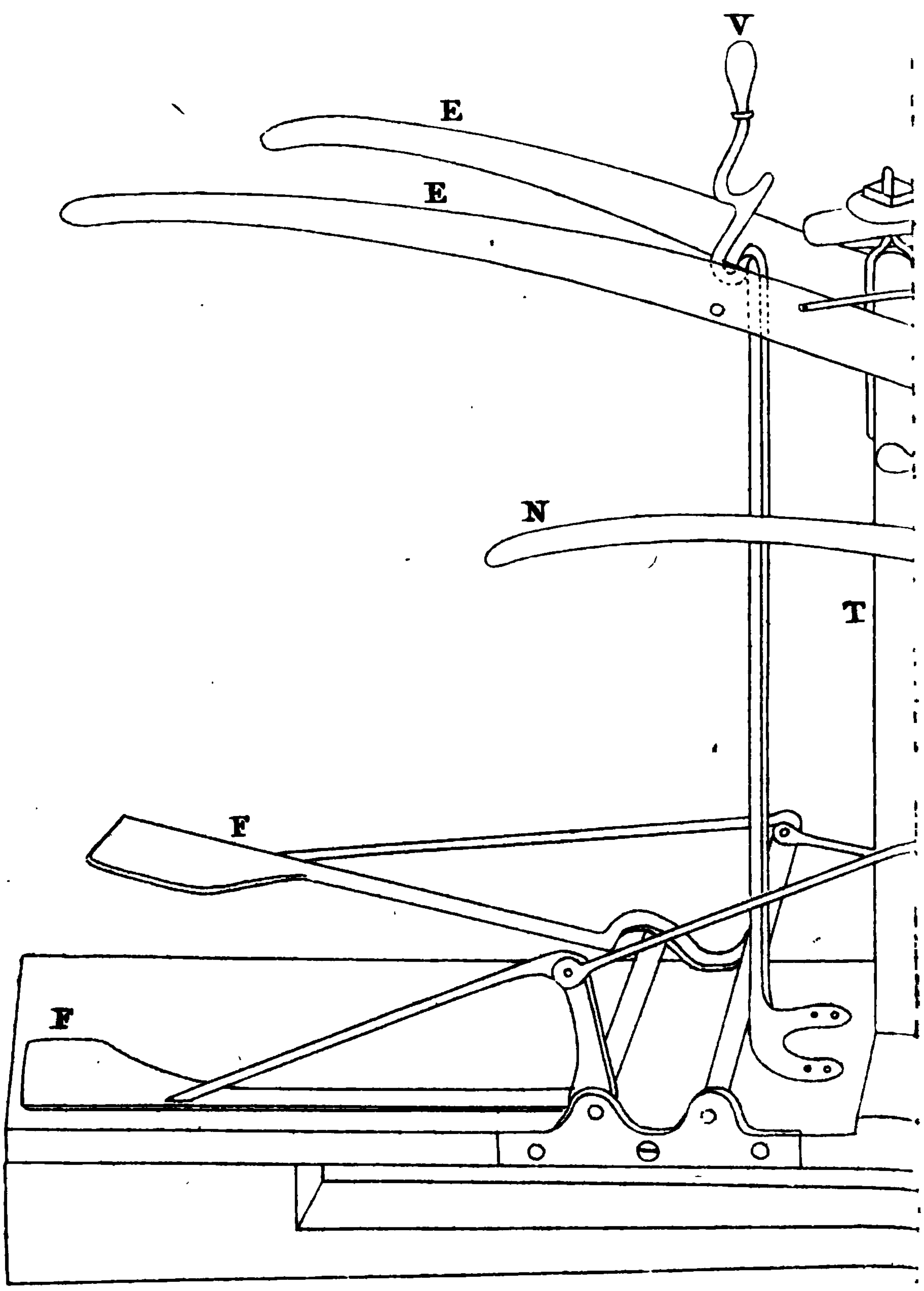


Fig. 2.



two side levers, to be worked by two men, when more power is required. P P, are two other pedals, on which a man treads alternately, to give motion to the hammer, having an upright rod or chain to each pedal; one rod is connected from the right pedal P, to the lever O, which raises the hammer; the other rod, from the left pedal P, is connected to the handle of the hammer C; when the man treads on the left pedal P he acts upon the hammer C, and, by lifting the lever O with both hands at the same time, adds double power to the blow. Q, is a wooden spring or stop, which prevents the hammer rising too high, and accelerates the fall. R, is a bridle, which supports the wooden spring Q. S S, are two iron standards, with holes in each, to raise or fall the said spring. T, is a wooden standard, to support one end of the wooden spring Q. V, is a steel-tempered spring standard, to support the hammer whilst out of action; it also gives ease to the spring, and prevents the heat of the anvil from softening the face of the hammer. U, is a solid block of oak, on which the anvil stands. W, the anvil, with a hollow dove-tail on the top, for the reception of different faces, as the various kinds of work may require. X, a steel face, dove-tailed in the anvil. Y, a steel spring, which lies beneath the hammer-handle, but only touches it when the hammer falls: this spring, when the heated metal is laid upon the anvil, and in a soft state, prevents the hammer falling upon it with its full force. It gives a recoil to the hammer, and permits the workman to modify or shorten the stroke of the hammer with quickness, ease, and regularity. Z, a weight hung on the arm of the quadrant K, in order to counteract the power of the hammer occasionally, when light work is to be forged.

Fig. 2, is a bird's-eye view of the hammer-wheel, and is marked with similar letters, to shew the same parts. 1, 1, are chains by which the rack G raises the hammer. 2, 2, are chains which raise or depress the hammer by the motion of the levers E E.

Fig. 3, is a hammer-head, with a face let into it; and which face may be taken out and changed to suit different work.

Improved Method of Embanking.

By Mr. JOHN SMITH, *of Chatteris.*

From the COMMUNICATIONS to the BOARD of AGRICULTURE.

I FIND from the public papers, that the premiums offered by the Board of Agriculture include draining low lands; and indeed, if stagnant water is not well drained off such lands, no improvements of any value, for either corn or grass, can ever be adopted on any fens or low lands.

But previously to my describing a valuable and improved mode of banking, I will concisely observe, that the great level of the fens is divided into three large levels; and that each of these levels is subdivided into numerous districts by banks: but as these banks are made of fen moor, and other light materials, whenever the rivers are swelled with water, or any one district is deluged either by rain, a breach of banks, or any other cause, the waters speedily pass through these light, moory, porous banks, and drown all the circumjacent districts. The fens have sometimes sustained 20,000*l.* or 30,000*l.* damage by a breach of the banks; but these accidents seldom happen in the same district twice in

twenty

twenty years; the water, however, soaks through all fen-banks every year, in every district; and when the water mills have lifted the waters up out of the fens into the rivers in a windy day, a great part of the water soaks back through the porous banks in the night upon the same land again.

This water that soaks through the bank drowns the wheat in the winter, washes the manure into the dikes, destroys the best natural and artificial grasses, and prevents the fens from being sown till too late in the season. This stagnant water lying on the surface, causes also fen agues, &c. Thus the waters that have soaked through the porous fen-banks have done the fertile fens more real injury than all the other floods than have ever come upon them.

I have been much concerned in fen-banking from my youth, and though I now farm upon a large scale, yet I am still much employed in superintending fen-banking and draining low-lands; not only in the fens, but also in some high land counties, at a considerable distance.

I had some time back devised the plan which I now find to answer so well, but found it extremely difficult to prevail with any gentleman who possessed a proper district, to give it a trial: however, this last autumn, I prevailed with a gentleman in the parish where I reside to try the following plan, which proves equal to my most sanguine expectations.

Plan of improved Banking.

I first cut a gutter, eighteen inches wide, through the old bank, down to the clay, (the fen substratum being generally clay,) the gutter is made near the centre, but a little on the land-side of the centre of the old-bank. This gutter is afterwards filled up in a very solid manner

with

with tempered clay; and, to make the clay resist the water, a man in boots always treads the clay as the gutter is filled up. As the fen-moor lies on clay, the whole expense of this cheap, improved, and durable mode, of water-proof banking, costs in the fens only six-pense *per* yard. This plan was tried last autumn on a convenient farm, and a hundred acres of wheat were sown on the land. The wheat and grass lands on this farm are now all dry, whilst the fens around are covered with water. This practice answers so well on this farm, that all the farmers in this parish are improving their banks in the same manner, and some have begun in adjacent parishes. If the plan be noticed by the honourable Board, and published, it will soon spread through the fens, and other low lands, and produce inconceivable advantages to agriculture in many parts of the British empire.

On burning Lime with Peat.

By Mr. DODGSON, *of Grahamonset, in the County of Cumberland.*

From the COMMUNICATIONS to the BOARD of AGRICULTURE.

I OCCUPY a small farm (my own property) in the north-east district of Cumberland; and, in the course of ten years experience, I find, that in point of comparative expense, quickness of the process of burning lime, &c. that peat in many situations is preferable to coal. As to the expense, a man, with a boy to wheel out the peat, will dig as many in one day as will burn fifty or sixty Carlisle bushels of lime (the Carlisle bushel is equal to three Winchester ones). The expense of drying them is not more than the digging, being in the whole about six shillings.

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The coal at the pit in our neighbourhood is sold by measure at one shilling *per* quarter, and costs twelve shillings to burn the same quantity of lime, besides the expense of men and horses, drawing the coal perhaps three or four miles to the kiln. A great advantage in favour of peat when it is within a few yards of the kiln, as mine is.

The quickness of the process with peat is surprising, for in twelve hours after I put fire to the kiln I have lime ready to draw; in burning with coal, none can be drawn for two or three days; and nearly double the quantity of lime is produced every succeeding day than can be with the use of coal, owing to the peat keeping the limestones in an open porous state, and admitting a brisk circulation of air; for the same reason the limestones cannot be run into a solid lump, with excessive heat, as sometimes happens with coal.

Of the proportion of peat to stone there is no certain criterion, as peats are not all of the same quality; some stones are also easier burnt than others; consequently two or three days experience in burning is better than twenty pages of description. As stated above, I have peat at half the value I could have coal; in some cases it would be one-third the value of coal, and in some situations even equal, especially when far to drive to the kiln, as peat, being a more bulky article than coal, requires more cart-loads of it to a given quantity of lime than it would of coals. The wetness of seasons is no objection to peat; as I find, by experience, that peat when about half dry will burn lime as well as when thoroughly dry, only the process of burning is a little slower. Peat may be stacked near the kiln, and burnt when convenient; or if burnt in summer, taken from the ground it is dried upon without stacking. I take no particular care in put-

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ting in the peat, only throwing in a layer of peat and another of stones, taking care to have the lime well burnt: the stones I break no smaller than others in our neighbourhood who use coal.

This district of the county abounds with good limestone. The farmers generally burn their own lime; and even when coal is used, can get it cheaper than purchasing it at the kilns that burn for sale. I lately burnt one hundred and seventy Carlisle bushels of lime with peat, which, besides my own and servants' work, cost me only two shillings, and this work not much more than what the tedious attendance of men and horses would have been at the sale lime-kilns. Last summer I burnt two hundred and seventy Carlisle bushels of lime (that is near one hundred quarters, ten heaped measures to a quarter) with peat about half dry, and got good lime. I had only five men one day digging peat for the above quantity, the rest of the work was done with women and boys.

I have used lime burnt with peat in building, in compost for meadow land, and for arable land, at the rate of thirty-five or forty Carlisle bushels *per* acre. I prefer using it upon arable land for a potatoe or turnip crop, when hot or fresh burnt; as I once made an experiment, and found that it had the advantage in the succeeding crops of barley, clover, and oats, than when spread cold.

The kiln I use is what is called a common draw-kiln, is not a large one, but is sufficient for my farm.

A kiln should be built on the declivity of a hill, to make it easier of access at top, and its foundation easier cut. A decent farm-kiln for burning either with peat or coal should be two and a half feet wide at bottom, and expand gradually to sixteen feet high, and seven, or

seven

seven and a half, feet diameter at top. May be built on a larger scale, but the less diameter at top, in proportion to the deepness, the better.

I should be happy if the interest of agriculture was in the least benefited by the adoption of the knowledge of my peat-burning plan. There is certainly many farms in the United Kingdom that abound with peat-moss and limestone; in this case the farmers might employ the poor of the neighbourhood, and their own servants and horses, without going off the farm, perhaps ten or fifteen miles to sale lime-kilns, with the additional advantage of having their lime cheaper. And in a national point of view, if we consider the great demand for coal, and its exportation from Britain to all parts of the world, certainly that valuable mineral cannot be too much economized, especially if a substitute can be found for it as may be in peat.

Observations on Manures. By Lord MEADOWBANK.

From the COMMUNICATIONS to the BOARD of AGRICULTURE.

I HAVE looked over, with much pleasure, Mr. Somerville's outlines of the fifteenth chapter of the intended Report of the Board of Agriculture. At the same time there are some advices in it which appear to me ill-founded; and, from considering the great weight that Report must have with the public, I have not only put on the margin a few notes, but am induced, with the liberty of an old acquaintance, to trouble you with two or three remarks, at more length, on some doctrines in it, which, if I may judge from my own experience, now not a short one, stand much in need of correction.

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A complete fermentation of dung is recommended; and with that view the structure of dunghills is prescribed; and as a corollary, the putting it in the land before winter, or when the plants to be nourished are not in a growing state, is dissuaded, from the supposed waste it must suffer in the ground, before the plants can get the benefit of it.

I have ever found, that instead of dung being the richest manure when completely fermented, it should, if possible, be laid on when very imperfectly fermented; but, nevertheless, when the process is going on at such a rate, as that it must continue after mixture with the soil till it is completed. Every gardener knows that the dung used in hot beds has little effect in comparison of fresh dung; and every farmer knows that a dunghill, which has by any accident been kept for years, is of little more value than so much very rich earth. Every person of attention too, must have remarked the great effects which ensue from turning over a dunghill recently before using it, and that composts operate most powerfully if used when sensibly hot, from the activity of the fermentation which the recent mixture of the ingredients has occasioned, and when consequently that process is very far from being completed. Besides, it is very properly observed in the outlines, that much manure is lost from the valuable effluvia that escapes when the upper surface and sides of dunghills are exposed to the sun, rain, and air. It is well known, that these agents powerfully promote fermentation; and surely it deserves consideration, how far the volatile matter extricated in the course of the process of fermentation, is not itself a valuable manure, with which it may be of the greatest importance to impregnate the soil. And there is no sort of doubt that the loss of weight, which dung suffers in a fermenting dunghill, though

though supplied with moisture sufficient to compensate the evaporation of aqueous particles, is extremely considerable.

According, however, to the practice recommended in the outlines, dunghills are to be constructed in a way to favour a complete fermentation, and only the fermented residuum is to be applied to the soil; a residuum which is supposed to be full of a nutriment for vegetables, soluble in water, and easily wasted away by rains; and being thus subject to waste in the soil, it is allowed to remain in the dunghills till the season when vegetables have most occasion for it.

Now, if it is considered, that a farm dunghill is formed by degrees, and that in good husbandry it is to serve not only one crop, but a succession of crops, till the husbandman has manured the whole circle of his farm, you will perceive that the advice neither suits the origin of the manure nor the purpose of it. The outlines have not gone so far as to lay it down, that the longer a dunghill is kept it is the better manure; or that it remains in a state of perfection after the fermentation is carried on for a given time: yet, unless this proposition is asserted, the first made dung must, according to the directions given, be in a very different state from the last made, when the dunghill is used; and it must on the whole be an unpromising manure, which, though it ought to operate for a series of crops, is to be soluble in water, and to suffer much loss if laid on the soil a few months before the growing-season.

It appears to me, that both reason and experience dictate the retaining of the first-made dung in a state of fermentation, so slow or imperfect, that it may suffer little till after being turned over with the later made dung, it forms one powerfully fermenting mass; and that then it

should be put into the soil, when the process is so far advanced that it will be completed, when at the same time little loss of substance has yet been suffered, and when that volatile matter is afterwards extricated will diffuse itself through the soil. In these circumstances every thing is lodged in the soil that the dung can yield, either in point of mass or activity ; and at the same time it is in a state, when most likely to act as a powerful ferment, for promoting the putrefaction of the decayed vegetables lying inert in the soil. I certainly, therefore, approve of the preservation of dunghills from much sun and much wind, as well as from the redundancy of moisture, which is apt to overflow and wash away the manure : but I think the pressure which the feet of animals give them, especially of the lighter sort, does good, and prevents that violent fermentation which wastes the substance, and I think exhausts the fertilizing powers of dung. This pressure contributes to preserve it fresh till the time of employing it as a manure calls for putting it altogether, and at once, into that highly active state of putrefaction, which, though no doubt checked by its distribution in the soil, is sufficient to insure a gradual and complete dissolution and diffusion of its substance. This may be heightened at pleasure, by mixing with the dunghill, when turned over, ashes, lime, rubbish, fowl-dung, or other materials, according as the farmer judges it expedient to hasten the putrefaction of the dung when lodged in the soil, or to enable the soil to dissolve quickly inert vegetable matter contained in it ; and, according to my observation, if such matter abounds in it, the soil, when manure of this sort is added to it, seems to undergo a degree of fermentation which puts it even in a more favourable situation for an effective crop after it is far advanced than when actually going on. Unless, therefore, dung

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is to be used for composts, it appears to me clearly advantageous to get the dung into the soil as early as possible. It is always wasting somewhat when kept out of it; but when put into the soil in a proper state, there is the utmost reason to think that what is extricated goes all to fertilize. Give me leave to add, that I do not believe much is lost by dissolution in rain water. I could never discover any thing of the kind in the water of the furrows of a field properly manured and ploughed. The case, every person knows, is quite different in fields recently limed or dressed with ashes; but I am apt to think that the volatile and soluble parts of common dunghills have some attraction with the substance of soils, that prevents their escape. We know that common loam extracts the noisome smell of the woollen cloths used for intercepting the coarser oils that accompany spirits distilled from the sugar-cane, which scarce any detergent besides can obtain from it: and garden loam, impregnated as it must be with fermented dung, is certainly not easily deprived of its fertility by the washing of rain. I must also observe, that I take one of the great advantages derived from using dung with composts to be, the arresting and preserving the fertilizing matter which escapes in the putrefactive fermentation; and another to be, that dung there operates as a ferment, to putrefy substances not sufficiently disposed to putrefy with activity of themselves. You will observe, that this coincides exactly with the effects I have attributed to it upon soil, and affords a very useful corollary with respect to the substances to be used in top-dressings which are not to be covered with soil, *viz.* that if fermenting or putrefying substances are used, the process should have been completed, or nearly so, in a combination that has received the full benefit of it: that it is a great waste to spread

common

common dung on grass without having first mixed it with mud, loam, or other matter in which it has been dissolved and fixed; so that when spread on the ground, the loss, which would otherwise arise from fermentation and evaporation, is avoided. And, as is observed in the outlines, that if such a compost is used at the time when the plants are in a growing state, and in a way to cover it soon, it is by far the most advantageous method of laying it on.

Another point much insisted on, and certainly of great importance, is, that ground is to be limed but once; that light soils and poor clays suffer from a large quantity, which would benefit rich clay or strong loam; that periodical and moderate liming, except in composts, is absurd, &c. &c. I conceive, that sufficient attention is not paid in the outlines to the material fact, that lime, in its caustic state, is pernicious to living vegetables, that when restored to its natural state of limestone, it is not pernicious to any; that when caustic, it is soluble in water; but not so in its natural state; and that if, after being burnt, it is reduced to powder by water, is exposed to the air, and is mixed with the soil, it hastens quickly to its natural state; but that it arrives at this state more quickly in rich or loamy soils than in poor soils: besides, in its caustic state, the direct effect of lime is to dry, dissolve, and corrode, but not to putrify; whereas, in its natural state, it powerfully promotes putrefaction.

I have used lime of a rich quality, *viz.* eight-tenths of it calcareous earth, and the remaining two-tenths a blue clay, to a considerable extent as a manure; and after it was restored to its natural state, found that the more of it I gave to even the poorest and thinnest clays, or to the poorest gravel, the soil was so much the more improved; but that, on the other hand, even a very small quantity

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of quick lime, if harrowed in with the seed without dung, was in such soils pernicious to the crop. I believe no farmer will say that he ever saw his crop suffer from the rubbish of an old wall, which is lime restored to its natural state, (containing three-fifths gas of its weight by Mr. Higgins's experiments,) nor from lime where dung was added, or where the lime shells had been saturated with dung-water, however poor the soil on which it was laid, or large the quantity employed. In the outlines also it seems to be allowed, that chalk and marle, which differ only in point of compactness from lime in its natural state, do not hurt weak soils, though used in great quantities. I conceive, therefore, that it may be laid down as a general rule, that any addition of lime to soils, whether rich or poor, cannot be permanently pernicious, and if restored to its natural state must be more or less advantageous. The best natural soils we know contain a very large proportion of calcareous earth. Those formed of rotted whinstone contain perhaps nearly one-ninth of calcareous earth; and still they are greatly benefited by farther additions. Delta ground, which is formed of the washings of soils of all descriptions, and the fertility of which is so inexhaustible, must contain a great proportion of calcareous earth; which is generally to be found somewhere in any large extent of country, and we know must abound in water, where it is required so copiously, in the production of the shells and bones of fishes. Lime, however, is still a manure to delta ground; and I acknowledge, that so far from dissuading additional dressings of lime to land formerly well limed, I am convinced, by experience, of their utility; and am persuaded that such additions give a new activity to the soil, and ferment the fermentable matter in it, which the calcare-

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ous earth already incorporated with the soil, and entangled by various affinities, might otherwise suffer to remain sluggish and useless.

Farther, the frequent recommendation of putting hot shells into composts seems not a little questionable. This is certain, that one effect of such an operation is to destroy part of the ingredients that are otherwise useful; for the quick lime instantly saturates itself, not only with the watery matter in the composition, but with the gas to be found in putrefying and inflammable substances. Hence it sensibly burns and wastes dung; and the throwing it into the receptacles of the richest species of manure, which is a practice recommended in the outlines, I will venture to pronounce highly destructive.

I am far, however, from deciding that quick lime, in its state even of greatest causticity, may not be of use in certain composts. Perhaps, for example, in mixture with peat-moss, its powerful absorbent and caustic effects may be of use. The very burning part of the moss into a sort of ashes, may afford material aid to the putrefactive powers of the lime when restored to its effete state; and there is no doubt that the solubility of quick lime in water, by which it is so diffusible through composts as well as soils, may in many cases render lime quenched with pure water preferable to lime fully saturated, and become effete by exposure to the air or smoke, or by mixture with dung-water. This too is no doubt one of the great advantages derived from the use of quick lime, by means of spreading and harrowing it in, and in this way exposing it to a plentiful rain before it becomes effete and insoluble in water: for thereby every particle of the cultivated soil comes to be impregnated with a portion of lime dissolved in lime-water; but

but still, where lime is to be used, merely in order to heighten putrefaction in substances (such as dung or decaying vegetables) not averse to putrefaction from any quality which causticity would tend to destroy, I should certainly be inclined to prefer lime rubbish, or lime rendered effete by any means which does not consume manure in the process.

On the Phosphate of Lead. *By M.* Darnaud.

From the Annales de Chimie.

Several chemists of undoubted merit have been of opinion, that in treating the ores of phosphate of lead by the nitric or the muriatic acid, we ought to precipitate the oxyd from them by the addition of volatile alkali and the phosphoric acid by lime. In a Memoir, inserted in the "Annales of Natural Science of Madrid, 1803," I have recorded some new facts, which have convinced me of the inaccuracy of this mode of analysis.

When phosphate of lead is treated with the nitric or the muriatic acid, these acids dissolve the mineral, but do not decompose it, or at least its decomposition is performed, and can be performed, only in a partial manner; for if we pour phosphoric acid into a somewhat concentrated solution of nitrate and of muriate of lead, we obtain a precipitate of phosphate of lead, and whatever be the quantity of the precipitating acid which we add, we can never in this case effect the total elimination of the whole of the nitric acid. In fact, we still obtain crystallized nitrate or muriate of lead by the evaporation and refrigeration of the liquor. Now, if the phosphoric

acid decomposes in part the nitrate and the muriate of lead, how should the nitric and muriatic acids entirely separate the oxyd of lead from its combination with the phosphoric acid?

Moreover, whatever may be the quantity of nitrate of lead that is formed by decomposing the phosphate by the nitric acid, the precipitate which we obtain by the addition of volatile alkali, instead of being oxyd, is still only a phosphate of lead, of which we may easily convince ourselves by means of the blow-pipe.

If we afterwards examine the liquor by means of lime or a calcareous salt, we obtain only a small quantity of phosphoric acid. The nitric acid has therefore but incompletely decomposed the phosphate of lead. This effect cannot consequently be attributed to a result of the double attractions, the action of which were established by the presence of the volatile alkali, since it has been seen that the phosphoric acid, disengaged from all combination, decomposes in part the nitrate of lead.

100 parts of phosphate of lead dissolved in the nitric acid, gave by ammoniac a precipitate which weighed 94; and, by the addition of lime, the calcareous phosphate which I obtained weighed 4. Thus, by this means, the nitric acid separated only about a ninth part of phosphoric acid. The liquor contains still a small quantity of oxyd, as may be discovered by means of sulphurated hydrogene.

Though the muriatic acid has a great affinity with the oxyd of lead, so as to divide it with the sulphuric acid, as M. Descotils has shewn, yet it cannot be employed as capable of separating the whole of the lead from the phosphoric acid. Undoubtedly we eliminate by this means a greater portion from it than by the nitric acid; but

but if we add volatile alkali to the solution, in hopes of precipitating the oxyd of lead from it, what takes place with regard to the nitric acid happens here likewise.

We obtain, it is true, by evaporation, a considerable quantity of muriate of lead, and when we have employed the concentrated acid, in proportion as the liquor cools, we see this salt crystallized and precipitated in abundance to the bottom of the vessel; but if we separate this salt, and add volatile alkali to the liquor, we still obtain a precipitate of phosphate of lead. It frequently happens, that when we pour into the liquor which contains phosphate of lead with excess of acid, muriate of lead, besides the excess of muriatic acid employed, there is immediately formed a crystalline precipitate of muriate of lead, which was dissolved by the aid of the excess of its acid, and which is precipitated from it as soon as water is presented to it; but the precipitate disappears if we add a sufficient quantity of water to dissolve it.

Not only ammoniac, but also the caustic alkalies and alkaline carbonates are incapable of precipitating in the state of oxyd the phosphate of lead which exists in solution in the nitric acid; and if we dissolve this salt in caustic potash, and add to the solution any acid except the sulphuric, the phosphate of lead separates from it in proportion as the alkali is saturated by the acid.

But if we treat the ore well pulverized, by the sulphuric acid, according to the practice of Bergman, we may be certain that the whole of the oxyd of lead will abandon the phosphoric acid: in fact, it was by this means that I analysed the ore which formed the subject of the memoir above cited, and it was by endeavouring to analyze it by the other acids that I discovered their incompetency.

This ore contained phosphate of muriate of lead, besides yellow oxyd of iron; I am even obliged to conclude, that the muriate of lead was combined in it with an excess of oxyd, since distilled water dissolved nothing of a metallic nature from this ore when pulverized; and it was by distilling this mineral upon concentrated sulphuric acid that I discovered in it the presence of the muriatic acid; it condensed itself in the water of the recipient with which the neck of the retort communicated.

If we dissolve 100 parts of metallic lead in nitric acid, and precipitate the lead from it by means of perfectly neutral phosphate of ammoniac, the precipitate which we obtain weighs 133 parts, which gives 0,18 of phosphoric acid in 100 parts of phosphate of lead.

The nitric and muriatic acids are insufficient means for effecting the decomposition of the phosphate of lead.

It is not the oxyd of lead, but phosphate of lead, which is precipitated by the volatile alkali poured into the nitric and muriatic solution of the phosphate of lead.

The caustic alkalies and the alkaline carbonates produce the same effect as the volatile alkali.

Finally, there exists in nature muriatic acid combined with the oxyd of lead, and in the state of salt with excess of oxyd.

Report on a Method of measuring the initial Force of Projectiles discharged from Barrels either horizontal or inclined. Read in the Class of Physical and Mathematical Sciences of the National Institute, December 12, 1804, *by M.* PRONY.

From the JOURNAL DES MINES.

THE class charged Messrs. Bossut, Monge, and myself, to draw up a report on a method of measuring the initial force of projectiles discharged from barrels, proposed by Colonel Grobert, who constructed an apparatus of such dimensions that we could make use of it for preliminary experiments. We shall first submit to the class a description of this apparatus, and of these experiments; and after we have enabled it to form a judgment both of the method itself, and of the additions proposed by the inventor, for a perfect mechanical contrivance, intended for more accurate and more extensive experiments, we shall annex to the opinion we have ourselves formed on all these subjects, a brief notice of the methods hitherto employed in researches of this nature.

The following is a description of the apparatus. A horizontal revolving axis, about thirty-four decimetres in length, has at each of its extremities a disk, or circular piece of pasteboard, perpendicular to its axis. They have for their centres the same axis, to which they are fastened in such a manner that the whole machine can turn rapidly round without deranging the respective positions of its different parts.

The rotary motion is communicated to the axis and the two disks by means of a weight suspended to the end of a cord, which, after passing over a pulley, at the height of ten or twelve yards from the ground, rolls it-

self

self round the horizontal body of an axle fixed at the same level as the disks. An endless chain, which winds on the one hand round part of the wheel of the axle, and passes on the other over a pulley fixed on the rotary axis with the disks, transmits to that axis the motion which the weight communicates to the axletree and wheel during its descent.

This apparatus obviously possesses the merit of being simple, and, without entering into farther details, it may easily be conceived how it is capable of being employed to measure horizontal velocities. Let us suppose that the two disks are at rest, and that a ball traverses them in a direction parallel to the axis, or the line that passes through their centres; it is manifest that this axis will be in the same plane with the holes made in the disks; but if the disks turn round the axis while the ball is passing from one to the other, then the plane comprehending the axis of rotation and the first hole will not coincide with the second hole; and if a second plane be made to pass through the second hole and the axis, the angle formed by these two planes will be the measure of the arc described by any point of the disks while the ball traverses the space which separates them.

In order to measure the velocity of the ball, it is therefore required, 1, to communicate an angular, uniform, and established velocity to the system of the axis and its two disks; 2, to measure the arc comprehended between the two planes, passing through the axis and through each of the passages or holes which the ball has made through the disks.

In the experiments that were made, the motion became evidently uniform when the weight had arrived at nearly half of the vertical space which it traversed. This was ascertained by measuring at two different periods the

time

time that had elapsed during the third and the fourth quarters of the descent, and afterwards comparing that time with the corresponding spaces which had been passed through. For these measures, two excellent time-pieces that marked the seconds, the one by Louis Berthoud and the other by Breguet, were employed.

In almost all the experiments, instead of the measure of the vertical space we substituted that of the number of turns, and fractions of turns, made by the body of the axletree and wheel during a given number of seconds, which in every respect was much more precise and convenient.

Then to measure the arc passed over by the disks while the ball was travelling from one to the other, we placed before each of these disks a skreen, or fixed piece of pasteboard, in such a manner, that the ball on its way first passed through the first skreen, then the first disk; afterwards the second skreen, and, lastly, the second disk. When the piece was discharged, the whole of the first disk was placed opposite to that of the first skreen, and these two holes were in the same straight line with that made in the second skreen; a wire passed horizontally through the centre of the latter hole, pierced the second disk; and the arc, having its centre in the axis of rotation comprised between the extremity of the wire and the centre of the hole made by the ball in the second disk, gave the measure of the angle described by the machine of the two disks while the ball was travelling the length of the axis.

It is evident that the fixed skreens, which give the absolute direction of the ball in the space, furnish the means of ascertaining the want of parallelism, if any there be, between that direction and the rotary axis of the disks.

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The barrel employed to discharge the projectile was fixed horizontally and parallel to the axis of the disks, at such a distance from the first disk, that the agitation communicated to the air by the explosion of the powder, could not affect that of the disk.

An apparatus, exactly similar to that above described, was set up by Colonel Grobert, on a piece of ground belonging to the School of Bridges, &c. where, with the commissioners, he made, in the years 1802 and 1803, a great number of experiments, at some of which were present several officers of the engineers and artillery, among whom were General Marescot and the senator La Martillière.

This apparatus had not by far the dimensions and the perfection of which it is susceptible, and which the inventor purposes hereafter to give it. Accordingly, the object of the commissioners in making trial of it was not so much to furnish results useful to the artillery, as to ascertain the advantages that may be derived from it when constructed with all the improvements of which it is susceptible.

Before we proceed to the experiments, it may not be amiss to resolve a difficulty which naturally occurs to all persons not perfectly acquainted with the subject, and which arises from the enormous difference supposed to exist between the velocity of the projectile discharged from the barrel and the angular velocity that may be given to the disks. It is in fact concluded, from known experiments on the projectiles of artillery, that the time employed by the ball in travelling the distance of three or four yards between the disks must be much less than the hundredth part of a second, and it can scarcely be conceived that, during so short a time, the disks can possibly describe a perceptible arc.

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Here follows the solution of this difficulty. When the motion has become uniform, the axletree with the wheel commonly made 0,833 turns in a second, and each turn of this wheel was equal to 7,875 turns of the axis with the disks, which consequently made 6,56 turns *per* second. Therefore the point placed on a disk, at the distance of one yard from the axis, travelled 41 metres in the space of about a second, which for $\frac{1}{100}$ of a second, gives 41 centimetres, a length more than sufficient to furnish very exact measures.

The experiments were made with an infantry-musket and a horse musketoon, the barrels of which were respectively 1,137 and 0,765 metres of interior length. They were at first charged with cartridges from the arsenal; but the first series of experiments being more regular than had been expected, we were encouraged by this success to employ more precision in the charges, and more care in the proofs. The balls were accurately weighed; their mean weight was 24,7 grammes, and each of them was projected with half its weight of powder.

The following is the formula employed to calculate the velocity of the balls.

The semi-circumference which has 1 for its radius - - - - - - - - - - - - - - $= \pi = 3,141$

The ratio between the respective number of the turns made, during the same time, by the wheel of the axle and the pulley of the axis with the disks - - - - - - - - - - $= k$

The time employed by the wheel of the axle to make the number of turns n - - $= t$

The distance of the hole made by the ball in the second disk from the axis of the disks $= r$

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The arc passed over by that hole while the ball goes from one disk to the other - - $= a$

Distance between the two disks - - - $= b$

Velocity of the ball between the same disks $=$ V.

We have then the following equation.

$$V = \frac{2\pi n}{k t} \cdot \frac{r}{a} b.$$

It may be of some utility to subjoin to this formula a table of some experiments; and we shall therefore give the following ten, made with the musketoon.

Number of Experiments.	n	t	a	V
		Seconds.	Metres.	Metres.
1	8	10	0,3510	402,3
2	8	10	0,3800	371,7
3	8	10	0,368	362,5
4	15	22	0,296	384,1
5	15	22	0,264	430,7
6	10	18	0,268	345,7
7	15	16	0,392	398,8
8	15	16	0,392	398,8
9	15	16	0,416	375,8
10	15	16	0,360	434,3

Mean velocity - - - - - - - - $=$ 390,47

Constant value of $k = \frac{1}{7,873}$

All the values of a are referred to that of $r = 1$ metre.

The mean velocity deduced from the ten preceding experiments is 390,47 metres, very nearly the same as results from the whole of the experiments.

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The mean value of the velocity *per* second of balls discharged by the infantry-musket is 428 metres, the ratio of which to the preceding is nearly 11 to 10. These experiments seem to prove that the infantry-musket might be shortened without much diminishing its range; but, besides that the commissioners had no intention of deducing from these first trials any conclusion applicable to artillery, it is proper to observe, that there are military considerations, exclusive of those of range, which determine the length of the infantry-musket.

If we were desirous of selecting from among the accurate experiments hitherto published on the projectiles of artillery some proper for furnishing, as nearly as possible, an object of comparison with those mentioned above, we might take from the work of Dr. Hutton, those which he made with a barrel of the smallest dimensions, which he marks No. 1; its bore being 7 decimetres in length and about 51 millimetres in diameter. The general results stated in a table formed from the whole of the experiments, give, when the weight of the charge of powder is, as above, equal to half the weight of the ball, an initial velocity of 435 metres *per* second, which differs very little from the velocity found with the infantry-musket. Dr. Hutton's pieces numbered 2, 3, and 4, which were longer, gave mean velocities more considerable.

The commissioners made some experiments with half charges, that is, by expelling the ball with one-fourth of its weight of powder. The mean value of the velocity of the ball thus discharged by the infantry-musket was found to be 254 metres, and by the horse musketoon 252. These two velocities are obviously almost equal, and exceed the halves 214 and 195 of those given by the whole charges. It may be presumed, that

these circumstances are principally owing to the complete inflammation of the powder which takes place in the case of half a charge.

Finally, the commissioners, in order to multiply as much as possible their experiments on the application of Colonel Grobert's apparatus to horizontal firing, wished to deduce from it some data relative to the resistance of the air to the motion of a ball, whose diameter was between 15 and 16 millimetres. The mouth of the piece, which was at first at the distance of 2,35 metres from the first fixed skreen was removed to 20,79 metres.

In this position the velocity with which the ball discharged from the infantry-musket passed over the interval between one disk and another was found to be at the mean value of 345 metres *per* second, instead of 428. The diminution is in the proportion of 42 to 34. The experiments of the last kind are few in number, and we shall deduce from them no conclusion; nor shall we say any thing concerning some trials, made with a view to determine the loss of velocity sustained by the ball while passing through the two first sheets of pasteboard; the principal object of our essays being, as we have already mentioned, not to employ this first apparatus in improving the science of artillery, but to obtain some idea of the advantage which that science may derive from it, when it is executed with that precision and perfection of which it is susceptible.

One of the most important alterations proposed by the author, is to increase the diameter of the disks, and the length of their axis, in such a manner as to render them capable of determining the initial velocities of common balls of various calibres. It would be difficult to assign before-hand, and without any preliminary trials, the term of this augmentation compatible with the possibility

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and accuracy of experiments; but there is no reason to doubt, that the apparatus we used might be made of much larger dimensions, so as to be fit to be employed for trials with cannon.

Colonel Grobert proposes another improvement, which derives its principal utility from that already mentioned, and the object of which is to afford the means of traversing the disks by discharging the balls in different directions, from the horizontal to that which makes half a right angle with the vertical line. To accomplish this end, he has invented the following contrivance, which is both simple and easily consructed: instead of making the disks turn round upon one common axis, he gives to each a distinct horizontal axis, to which he affixes a pulley. The other axletree has two wheels, of equal dimensions, corresponding to the two pullies, and two endless chains, each of which passes round a wheel and a pulley. The rotary motion which the axletree receives from the descending weight is thus communicated to the disks, and the dimensions of the wheels and pullies may be accurately regulated, that the disks may turn round together, and make exactly the same number of revolutions in the same time. This condition being fulfilled, the supporter of one of the disks (that which is the farthest from the cannon) is disposed in such a manner that it can be raised in a vertical direction, and fixed at different heights, for each of which are added a few links to the chain, corresponding to that disk, in order to give it the requisite length; and thus, by lowering the cannon, you are enabled to traverse the disks in different directions inclined to the horizon. It may be remarked, that the projection of the surface of the disks on the plane perpendicular to the line of firing decreases in proportion to the inclination of that line; but this is a very

small

small inconvenience, the greatest diminution that takes place being made in the ratio of about 7 to 5, and leaving a sufficient field for pointing with all the precision that can be desired.

It will not perhaps be so easy as might at first be imagined; to adjust the wheels, the pullies, and the cogs, in such a manner that the two disks may turn exactly together: but yet we are of opinion, that there is nothing in this part of the apparatus which might not be made by any attentive and ingenious workman. Besides, if the machine be strong, and the cogs well executed, there is an infallible method of preventing the errors resulting from the want of coincidence that might exist in the motion of the disks. This method consists in counting the turns made by the wheels from the moment the piece is fired till that when the machine stops, and in causing these wheels to make the same number of turns in a contrary direction, so that the disks should return to the respective positions in which they were when the piece was fired.

We shall suppress many details relating both to the inclined range and the different contrivances invented by Colonel Grobert, to render trouble and attention unnecessary in the experiments. By means of these contrivances, of which his memoir and the drawings that accompany it, afford a complete description; the weight which sets the machinery in motion, having arrived at that point of its course where its motion becomes uniform, rests on two triggers, one of which causes a pendulum to oscillate and mark the time, and the other establishes a communication between the motion of the axletree and a system of toothed wheels and pinions, provided with indexes to count the revolutions of the wheels. The weight, having reached the lower extremity of its

course,

course, presses other triggers, which serve to fire off the cannon, and to stop the counter of time, and that of the number of turns. These different methods may be useful, but it is frequently attended with inconvenience to multiply them too much, and to give to a piece of machinery a complication that renders it liable to be easily deranged, and which may very well be dispensed with, if the observers have had any practice, and bestow any attention.

The above statement will be sufficient to give an idea of the utility that may be derived from the apparatus of Colonel Grobert; we shall now add to it a brief notice of the methods hitherto employed in researches of the same kind.

It is not more than sixty years since mathematicians began to apply experience with success to the theory of projectiles. Benjamin Robins, who appears to us to have opened the way, or at least to have published the first experiments worthy of the attention of scientific men, employed for the purpose of ascertaining the initial velocity of musket balls, a pendulum, against which he discharged his projectiles, and the velocity sought was deduced from the amplitude of the oscillation. The same mathematician, when he had immediate and particular experiments to make on gunpowder, deduced his results from the recoil of a cannon, fastened to the lower part of the same pendulum *.

Eight or ten years after the first experiments of Robins, the Chevalier d'Arcy, of the Academy of Sciences, published in the Transactions of the Academy for 1751, a Memoir on the Theory of Artillery, containing a series of experiments, made with great skill and care, in which

* See his "Principles of Gunnery."

he

he employed, nearly in the same manner as Robins, two pendulums, against one of which he discharged the ball, while the other, to which the cannon was suspended, served to measure the recoil. With the same instruments were made the important experiments described in the "Essais d'une Theorie d'Artillerie," published by the same author in 1760.

Fifteen years afterwards Dr. Hutton made at Woolwich new experiments with the pendulum on projectiles much heavier than those employed by Robins. The detail of these experiments is printed in the Philosophical Transactions for 1778.

About the same time our colleague, Count Rumford, resumed and improved the method of employing pendulums. He discovered a very simple way of suspending the cannon, so that the recoil should take place without the axis ceasing to be horizontal. Dr. Hutton speaks in high terms of these experiments, which are described in the Philosophical Transactions for 1781, and which the author has since reprinted in a collection of Memoirs, intituled, "Philosophical Papers, &c. London 1802."

Lastly, Dr. Hutton was engaged, during the years 1783, 1784, 1785, and 1786, in a numerous series of experiments, made with great care and expense, on both kinds of pendulum. The collection of his Memoirs, inserted in the Philosophical Transactions, and recently translated into French by Colonel Villantroys, may be considered as the most complete and the most instructive practical treatise on projectiles that has ever appeared.

The apparatus proposed by Colonel Grobert, is obviously very different from those employed by the authors we have just mentioned; and whatever merit may be ascribed to the experiments made with pendulums, it

will

will undoubtedly be admitted, that it may be of utility to make new ones by a very ingenious method, which combines simplicity with economy, and leads to the proposed end in the most direct manner; the velocities sought being deduced only from the observation of the time employed by a moving body, to make a certain number of revolutions round a fixed axis, and which observation is not embarassed by the considerations and dynamic calculations required by Robins's method.

We have not yet said any thing concerning the labours of Antoni on the subject of this report; we cannot, however, forbear mentioning a machine, described by him in his Essay on Gunpowder, which he says was invented by a mechanician named Matthey. It consists of a horizontal circle, supported by its centre on the upper extremity of a vertical axis, and serving as a base to a hollow cylinder of paper. To this cylinder a rotary motion round its axis is given by means of a weight affixed to a cord, which passes over a pulley, and the projectile being discharged horizontally, when the angular velocity has become constant in the vertical plane comprehended by the axis, it traverses the cylinder in two points. The distance of the second point from the diameter passing through the first, gives the measure of the arc described by the machine during the passage of the projectile into the interior of the hollow tube.

From this description it is incontestable, that the fundamental idea of the process for comparing a circular with a rectilinear motion belongs to Matthey; but without entering into any detail on the inconveniences of his machine, to which no doubt must be ascribed the little use that has been made of it, we shall content ourselves with observing, that the apparatus of Colonel Grobert differs from it essentially:

 1. In

1. In the horizontal position of the axis of rotation. The result of this first difference is, that the axis can never be met by the projectile, which renders it perfectly easy to ascertain the solidity and regularity of the position and motion of the disks.

2. In the circumstance that the projectile does not traverse a cylindrical surface, but two vertical planes, the extent and distance of which may be considerable, and which may therefore furnish very accurate measures.

3. In the advantage which it affords, and which is not possessed by any other apparatus hitherto known, of measuring the velocities of balls of different calibres, discharged in directions inclined to the horizon.

It now remains for us to give an account of some experiments which we made to ascertain, that the ball underwent no sensible deviation in traversing the disks. It is manifest, from the first principles of dynamics, that, at the moment when this ball is in the plane of a disk in motion, it receives, perpendicularly to its direction, an impulse, which, according to certain mathematical hypotheses, would give it in a direction parallel to the plane of the disk, a velocity nearly equal to that of the point where it happens to be, (the mass of the ball being very small in comparison to that of the different moving parts of the machine,) and then the velocity of the ball calculated according to the formula given above would be infinite. The actual phenomena differ considerably from those deduced from such hypotheses, in consequence of the compressibility of the disks, their little hardness, and the prodigious rapidity with which they are penetrated *; (the

* It is proper to give a brief statement of the reasoning on which these assertions are grounded, Every substance in nature being more or less compressible, the state of final motion resulting from the action of

(the duration of the passage of the semi-diameter through the disk not being more than the forty-thousandth part of a second); but it is still very important to determine with accuracy the influence which they have on the results. One of the commissioners is engaged in the analysis of a dynamic problem from which this determination may be concluded *a priori*; but as a parallel conclusion would not rest on physical data sufficiently certain, he preferred to verify by experiment whether the deviation were or were not to be appreciated. For this purpose he placed three fixed skreens, at equal distances from each other: the second and the third of these skreens being placed respectively before the first and second moveable disk. It is easy to conceive that, admitting the hypothesis of deviation, the hole made by the ball in the third fixed skreen could not be in the same vertical plane with those made in the first and second skreens, and that this deviation might therefore be easily measured and ascertained.

The apparatus being arranged in the manner we have described, several balls were fired Each time a plumb-line was placed before the centre of the hole made in the

of two bodies on each other, is not acquired at the very moment of contact, but after a fixed time, which is extremely short; and the bodies during their contact pass through the state of intermediate motion between initial and final. From these incontestable facts, if one of the bodies escapes from the action of the other before the instant when, by the natural effect of the collision, they would have ceased mutually to press against each other, the state of motion at which that body will really arrive in this case will differ so much the less from its initial state, and so much the more from that in which it would have been, had the collision been consummated, the shorter has been the duration of the contact; and this duration may be so short as not sensibly to affect its initial state. This is the case of the experiments mentioned in the text.

 first

first skreen; and taking in a line with it the centre of the hole made in the second skreen, it was very easy to perceive whether the centre of the third hole was in the vertical plane comprehending the two other centres. These observations were made with care and precision, and yet it was not possible to discover any deviation that could be calculated in the direction of the line passing through the centres of the three holes; consequently the motion of the ball through the moving disks is perfectly the same as if those disks were at rest. We are, however, of opinion, that it will be useful constantly to employ three skreens, arranged in the manner above mentioned, in any future experiments on this subject. In this manner it will be possible to ascertain whether there is no deviation, or, to observe it, if it is perceptible; and it will undoubtedly be perceptible either in cases when small velocities are communicated to the projectile, or in general in those when the ratio between that velocity and the resistance experienced by the ball in passing through the disks, shall exceed certain limits.

It may not be amiss to add, that the distance of the piece from the farthest skreen was about twelve metres, and that there was no reason to apprehend the inflexions observed by Robins in distances of about one hundred metres; inflexions which, according to him, invariably render the trajectory a curve with a double curvature.

What we have said concerning the imperceptible effect which the action of the disk has upon the ball to produce a deviation, proves, in the strongest manner, that the re-action of the ball on the disk cannot diminish its velocity in any sensible degree.

This conclusion might, besides, be deduced from various other facts relating both to the mechanism of the

apparatus

apparatus and to the data furnished by the experiments, but particularly by the measure of the time before and after the discharge of the piece: but we think it unnecessary to enter into details of that kind.

Conclusion.

In our opinion, the contrivance for measuring the initial force of projectiles discharged from fire-arms, in directions both horizontal and inclined, proposed by Colonel Grobert, and conformable to the brief description contained in the above report, merits the approbation of the class. We shall add, that a series of experiments, made with an apparatus of larger dimensions, and executed with more care than that employed by the commissioners, might furnish results useful to artillery.

Discovery of a new Vegetable Substance. By M. Rose.

From Van Mons's Journal.

A CONCENTRATED decoction of the root of Elecampane *(Inula Helenium)* deposits, after standing some hours, a white powder, which, in appearance, has much resemblance to starch, but which differs from it both in its principles and in its manner of comporting itself with other bodies.

1. This substance is, in general, insoluble in cold water. Triturated with this liquid cold, it forms a white milky liquor, which soon deposits a heavy white powder, that floats upon the top of clear and limpid water.

2. It dissolves very well in boiling water. If we heat to ebullition one part of the white powder with four parts of water, we obtain a complete solution, which passes through

through the paper filtre whilst it is hot, but which, by cooling, acquires a mucilaginous consistence and a dullish aspect. After some hours, this solution deposits the greater part of the dissolved substance, in the form of a compact white powder.

A solution of one part of gum-arabic in four parts of water, is much thicker, of a more tenacious consistence, and froths slightly; which the solution of the elecampane powder does not.

3. When we mix the solution of the white powder with like parts of alcohol, it at first remains clear, but in a short time the powder separates in the form of a white swelled deposit, which floats upon a transparent liquor. A solution of gum-arabic becomes, upon the addition of alcohol, immediately milky, and retains this appearance for a long time, nor does there separate from it, even after several days, any thing of a pulverulent nature.

4. Thrown upon ignited coals, the white powder is gradually fused like sugar, and it is converted into vapour diffusing white, dense, pungent fumes, and an odour like that of burnt sugar: after this combustion there remains only a light residuum, which infiltrates into the coal. Starch exhales similar fumes, but it is not fused, and it leaves a much more considerable coaly residuum; and gum-arabic, under the like circumstances, exhales scarcely any fume at all.

Heated in an iron spoon, over a charcoal fire, the powder of elecampane-root is first fused, and dissipates itself, exhaling the fumes above described. As soon as the spoon becomes red hot, it burns with a brisk light flame, and leaves only an insignificant coaly residuum. Starch, under the same circumstances, is not fused, burns much more slowly, and leaves a considerable coaly residuum. Gum-arabic only sparkles, does not take fire,

and

and leaves a large quantity of coal, which is easily converted into greyish ashes.

5. By dry distillation we obtain, from the powder of elecampane, a brown empyreumatic acid, having a smell of pyroxalic acid, but not an atom of empyreumatic oil.

6. The nitric acid transforms the powder only into malic acid and oxalic acid, and when it is added in great excess, into acetic acid; we do not obtain an atom of saccholactic acid, which gum-arabic, treated in the same manner, furnishes in such great abundance, nor of the fat which is generated by the action of the nitric acid upon starch.

It results, from all these phenomena, that this species of farina, extracted from the root of elecampane, is neither starch nor gum, but a peculiar vegetable substance, which holds an intermediate rank between these two substances. It is probable that it exists in a great number of other vegetables, and that several products, which have hitherto been looked upon as starch, are of the same nature as this farina.

Intelligence relating to Arts, Manufactures, &c.

(Authentic Communications for this Department of our Work will be thankfully received.)

Account of a Patent, granted in France, (Brevet d'Invention,) for an Improvement in Weaving, to the Sieur DESPIAU, *Manufacturer at Condon, Jan. 5,* 1805.

THE invention renders it unnecessary for the workman to throw the shuttle with his hand, according to the ordinary method. The following is the mode of proceeding. The weaver, when he sets his foot on the treadles

treadles to open the warp, at the same time moves two springs, placed on each side of the loom, by which the shuttle is thrown at the moment when the frame is removed back as far as it ought to be. His hands therefore remain at liberty, and he can pull back the frame, either alternately with one or the other, or with both hands at once, when he wishes to make the texture closer. The experiments made on this loom at the conservatory have proved that a weaver may work a longer time at it, and with much less fatigue, than at the loom with the ordinary shuttle; that he may weave in twelve hours fourteen metres twenty-five centimetres, or twelve Paris ells, of a kind of yard-wide cotton stuff. It is certain that a good workman cannot make by the hand in the same time, more than four ells of the same kind of stuff, and six ells, at most, by the ordinary flying shuttle.

The same experiments likewise demonstrated, that this improved loom may be employed with advantage in the manufacture of all kinds of stuffs, particularly woollens, blankets, linens, &c.; that the additions and alterations required by ordinary looms will be attended with very little expense; that the construction of the mechanism by which the shuttle is thrown is simple, and requires no expense to keep it in repair; and, lastly, that it may be adapted to all the looms of the ordinary construction. The loom for weaving woollen cloth, for a single man, according to the invention of M. Despiau, has been simplified by M. Renon. From this it results, that in eleven hours one man can weave four ells and a quarter of cloth, of 3,600 threads, while, in the same space, two men with the common loom could only finish three ells three-eighths.

As the patentee is unable to supply all the demands that have already been made for his invention, he has resolved

solved to have models of it executed. All the parts composing these models, together with the box in which they are packed, weigh only twenty-eight kilogrammes, and are sold at the moderate price of thirty-six francs. With one of these models any manufacturer may himself adapt the new invention to his loom.

Messrs. Barbazan and Co. cloth-manufacturers, at the Gobelins in Paris, are fitting up all their looms on this principle. The following is a statement of the expense of each loom. Two springs, 40 francs; two treadles and counter-treadles, 12 francs; two latches, 5 francs; two swings of wood, 6 francs; stretchers for the frame, and a case for the shuttle, 12 francs. Total 75 francs. For looms for weaving woollen stuffs, silk, or cotton, up to an ell in width, the total expense is only 48 francs.

Method of purifying the Air of Gardens.

The following method of purifying the air in gardens intended for the production of melons and other fruits, has been discovered by M. Cotte, Professor of Mathematics at Calais. Take a cylindrical vessel, nineteen inches and a half in diameter and six inches high, filled with spirits of wine; plunge into the middle of it another glass vessel, three inches and a half in diameter, containing four cubic inches of mercury. This will be sufficient to purify a square of 6,237 square feet, having a radius of thirty-one feet six inches, and containing 65,488 cubic feet and a half.

Account of the Panemore, a Machine moved by the Wind.

Mechanics have lately been enriched with a curious invention by M. Desquinemare, the author of a composition for rendering linen and other stuffs impermeable to

air and water. He has named it *Panemore*, from three Greek words, expressive of its peculiar quality of being moved by every wind. This contrivance is a kind of globe, placed on the top of a mast, on which it always turns round with the wind. In consequence of the ingenious calculation of the curves, which this machine presents in all its points, the rotary motion is always in the same direction, be that of the winds as it may: their utmost violence, instead of being detrimental to its action, only augments its power. It likewise possesses this advantage, that its means increase in a cubic ratio when the wind doubles its velocity, and that by doubling the surface of the machine its power is increased eight fold. It is impossible to enumerate the uses to which this invention may be applied. To give a decisive and experimental demonstration of the justness of his theory, the contriver has made the first application of it to the ascension of water. By this new method he raises the water from a well twenty yards in depth, in the court of the water-proof cloth-manufactory at Paris, where this curious experiment may be seen. He has likewise applied it to the bruising of grains as food for animals, and purposes to employ it for grinding corn, for making oil, for the use of light-houses, the effect of which will be greatly increased by the rotary motion of the lights. He considers it as a powerful assistant in the navigation of rivers; and, in general, it will form a very economical substitute for the labour of animals and men in all machinery which do not require periodical attendance. The inventor farther presumes, that it will serve for an accurate anemometer, by which the force of the wind may be precisely measured.

Method

Method of making balsamic and anti-putrid Vinegar.

Take good white-wine vinegar, a handful of lavender, leaves and flowers, the same quantity of sage, leaves and flowers, hyssop, thyme, balm, savory, a good handful of salt, and two heads of garlic. Before this vinegar is used, it should have been infused at least a fortnight or three weeks; the longer the better. With this remedy Madame Gaçon Dufour, the author of several excellent works on rural and domestic economy, states that she has repeatedly cured poor labouring people who had received wounds so dangerous as to prevent them from working. Two or three days were sufficient to heal the wound so as to enable them to return to their occupations. This vinegar is likewise excellent for spasms and suffocation. By rubbing the hands and temples with it you may venture into foul air. On an occasion of this kind, the above-mentioned lady very recently experienced its efficacy. A draw-well was choaked up, and a man employed to open it fell down nearly suffocated. She rubbed herself well with vinegar, hastened to the poor man's assistance, and applied it to his nose and mouth. He recovered, and with the precaution of smelling to it from time to time, he completed his job without any farther inconvenience.

Valuable Properties of the Service-Tree, not generally known.

From various experiments made in Germany, it appears that the bark of the species of service-tree, called by Linnæus, *Sorbus Accuparia*, is well adapted to the tanning of leather; and that six pounds of this bark, col-

 lected

lected in autumn, furnishes as much tanning matter as seven pounds of oak-bark. The leather subjected to these experiments was of very good quality. The berries of this tree, which serve only to please the eye, or as food for birds, may likewise be applied to a very useful purpose. An ardent spirit, of very excellent quality, may be extracted from them. For this purpose, let the berries remain on the tree till they are perfectly ripe, and even till they have been a little pinched by the frost. When they are gathered, put them into a tub, and pound them with a large wooden pestle. Pour boiling water upon them, and stir the whole. When the heat has fallen to twenty or twenty-two degrees of Reaumur's thermometer, add to the mass a quantity of yeast, sufficient to produce a strong fermentation. You may know when it is over by the froth which begins to fall to the bottom of the vessel, and when a lighted candle held over it is not extinguished. The whole is then subjected to distillation. The spirit produced from it has a strong, and not very unpleasant taste. This, however, may easily be taken away by means of charcoal, reduced to powder, and eight pounds of which are employed for two hundred and eighty quarts of spirits. Barrel it, and close it up well, shaking the vessel three or four times a day, for two or three days; then filtre the liquor, and distil it again. The spirit obtained by this second distillation is perfectly limpid, and has a very pleasant taste and smell. Twelve pounds of the berries yield two quarts of spirit. The produce of each tree is about twelve pounds, so that the value of a plantation of any extent may easily be calculated. The pulp which remains after distillation affords excellent nourishment for cattle.

Remedy

Remedy for the pernicious Effects of Toad-stools, &c.

It is well known that fatal accidents frequently occur from the ignorance or carelessness of persons gathering noxious vegetables instead of mushrooms. A method of preventing their pernicious effects is practised in France, where it is stated to be an infallible remedy. It is this— Excite vomiting; employ laxatives and glysters; after the first evacuations administer one dram of vitriolic ether (sulphuric ether) in a glass of water of marsh-mallows. If the symptoms are alarming, it is necessary to give a glyster made with a decoction of tobacco.

Method of destroying Insects and Caterpillars.

In the spring of 1805 the extremities of the branches of the cherry-trees, in a certain district of France, were attacked by a multitude of small insects; the leaves curled up together, and became withered. On opening the leaves a great number of ants were found, which, jointly with the insect which began the havoc, completed the destruction of the branch. Recourse was had to the smoke of tobacco, previously taking the precaution to cover the trees. This method was three times employed, but always without success. The plum-trees, attacked by the same insects did not lose their fruit like the cherry-trees, but the animals covered them with greater rapidity, and without leaving any hopes of being able to extirpate them by cutting off the ends of the branches, as had been done with the cherry-trees. With those trees whose stems were not very high, the following remedy was found efficacious. After being abundantly watered, the trunk was covered with ashes; the insects were destroyed, and the ants quitted the tree: but with lofty trees this method is impracticable.

New

New Process for obtaining Sugar from the Beet-Root.

M. Achard's process for extracting sugar from the beet-root was so expensive that no advantage could be expected from it for ordinary uses. M. Hermbstädt, a celebrated chemist of Berlin, has discovered a method more easily executed, and by means of which it is expected that sugar will be produced at a rate considerably cheaper than that of the West Indies. It is as follows; After pounding the beet-roots in a mortar, subject them to the press, to extract the juice, which is then put into vessels, and clarified with lime, like that of the sugar-cane. This operation being completed, evaporate it to the consistence of syrup; leave the liquor to become cold, when you obtain raw sugar of a dark colour, and the syrup, which is left at the bottom of the vessel, may be applied to various purposes of domestic economy. From 100 lbs. of raw sugar you obtain by the first refining 80 lbs. of a well-crystallized sugar, inferior neither in quality nor whiteness to that of the West Indies. Two days are sufficient for accomplishing the whole operation.

List of Patents for Inventions, &c.

(Continued from Page 400.)

WILLIAM DEVERELL, of Blackwall, in the county of Middlesex, Engineer; for certain improvements on the steam-engine. Dated September 2, 1805.

SAMUEL CALDWELL, of Hathern, in the county of Leicester, Frame-smith; for machinery and apparatus to be attached or annexed to certain plain frames or machines called stocking-frames, plain-piece-frames, or any other frames, for the purpose of working, making, or manufacturing, silk, cotton, mohair, worsted, or any other

other sort of stuff whatsoever, into plain hose, or any plain sort of piece-work whatsoever, whereby these frames will work, make, or manufacture, all kinds of plain stockings and plain piece-work by mechanical machinery and motion. Dated September 21, 1805.

JOHN NYREN, of Bromley, in the County of Middlesex, Muslin-bleacher and Tambour-worker; for a mode of printing fancy patterns on silk and cotton lace net, instead of tambouring or working them in colours. Dated September 27, 1805.

STEPHEN CLUBB, of Colchester, in the county of Essex, Millwright; for an improved mangle. Dated September 27, 1805.

JAMES MACNAUGHTAN, of Great Queen-street, Lincoln's-Inn-Fields, in the County of Middlesex, Ironmonger; for a stove or grate, and range, upon a new construction, by which rooms will be much more effectually warmed than they now are, and the chimnies prevented from smoaking. Dated September 27, 1805.

ERRATA.

THE marginal situation of the references in the original specification of Mr. Sharples's patent led us into several inaccuracies in its publication in a preceding number of the present volume.

Page 242, line 15, a reference is made to the instrument figure A, instead of the following example B, which was omitted.

Indicials.

$$10 - 3 = 7$$

$$9 \cdot\cdot 5 + 7 - 9 = 3$$

then $3 \times 10 - 7 = 23$, number sought.

In page 243, from the first line to the end of the paragraph, a reference is made to the instrument B instead of the following numerical example C.

11 —

Indicials.

$$\left.\begin{array}{l} 11 - 3 = 8 \\ 9 \cdot\cdot 7 + 8 = 15 \end{array}\right\} \text{then } \frac{15-9}{2} = 3, \text{ then } 3 \times 11 - 8 = 25.$$

The instrument B wants two conspicuous points opposite to the figures 3 and 7: and the sense is altered by substituting the word figure, line 5, for the word plate, which refers to the metal only on which the two wheels are fixed.

What is included between the 10th and the 18th line of the same page relates to the drawing D in the original, and to the numerical example included with it; which latter was omitted. The following is the example omitted.

Indicials.

$$\left.\begin{array}{l} 11 - 5 = 6 \\ 10 \cdot 1 + 6 = 7 \\ \dfrac{9 \cdot 7 + 6 - 9}{2} = 2 \end{array}\right\} \text{then } \overline{2 \times 11} + \overline{9 \times 11 \times 5} - 6 = 511.$$

Then follows: "this rule will answer for any three consequent numbers, the middle one being even, as in the example E." The example has been omitted, and the explanation introduced without it.

Example E.

Indicials.

$$\begin{array}{l} 101 - 1 = 100 \\ 100 \cdot\cdot 84 + 100 - 100 = 84 \\ \dfrac{99 \cdot\cdot 11 + 100 - 99}{2} = 6 \end{array}$$

Then $6 + 100 - 84 = 22$ and $22 \times 100^2 + 606 - \overline{100 + 22} = 220484$.

Page 245, line 19, *for* let there be a spiral box, spring, and pully, *read* let there be a spiral spring, box, and pully.

Page 250, line 10, *for* general rule of walking, *read* general rate of walking.

Ibid. line 25, *for* point, *read* points.

END OF THE SEVENTH VOLUME, SECOND SERIES.

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